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THE WHALEBONE WHALES OF THE WESTERN NORTH ATLANTIC

COMPARED WITH THOSE OCCURRING IN EUROPEAN WATERS WITH SOME OBSERVATIONS ON THE SPECIES OF THE NORTH PACIFIC

BY

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Dr. Frederick W. True, the author of the present memoir, has here brought together extensive original data relative to the external and osteological characters of the large whales of the western North Atlantic, for the purpose of determining whether the species are the same on both sides of that ocean. The facts have been derived from a study of fresh specimens at the Newfoundland whaling stations, the collection of the United States National Museum, and the skeletons in other large museums of the United States. Special study was given to the type-specimens of American species proposed by Professor E. D. Cope and Captain C. M. Scammon, all of which, with one exception, were examined by the author.

The investigation is preparatory to a study of the geographical distribution and migrations of the larger cetaceans in the North Atlantic, which could not be undertaken until the identity of the species themselves was determined. Numerous facts, however, relating to the occurrence of whales at different points off the coasts of North America, and the seasons of their appearance and disappearance, have been assembled.

The results of the investigation show that several American species which have been proposed are quite certainly nominal, and that, as a whole, the species of the Atlantic coast of North America cannot be distinguished from those of European waters.

Some attention has been paid to the whales of the North Pacific. The information previously recorded has been brought together in orderly sequence and various new facts added, but the amount of material at present available is insufficient to serve as a basis for discrimination of closely allied species. It is certain, however, that the whales of the North Pacific, with one exception, bear an extremely close resemblance to those of the North Atlantic. The California Gray whale, *Rhachianectes glaucus*, has no counterpart in the Atlantic.

One well-known European species, the Pollack whale, *Balænoptera borealis*, not previously known in North American waters, was observed at the Newfoundland whaling stations while this volume was passing through the press.

The illustrations include views of the type-specimens of the species proposed

by Cope and Scammon; also numerous representations of the different individuals of the Common Finback and the Sulphurbottom, from photographs taken by the author at the Newfoundland whaling stations. The latter are of special value for the study of individual variation in these huge animals.

In accordance with the rule of the Institution this paper has been referred to a committee consisting of Doctor Theodore Gill, Associate in Zoölogy, United States National Museum, Doctor J. A. Allen, Curator of Mammalogy in the American Museum of Natural History, New York, and Doctor Leonhard Stejneger, Curator in the Department of Biology, United States National Museum.

S. P. LANGLEY,
SECRETARY.

Smithsonian Institution,
Washington, D. C., June, 1904.

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THE WHALEBONE WHALES OF THE WESTERN NORTH ATLANTIC, COMPARED WITH THOSE OCCURRING IN EUROPEAN WATERS; WITH SOME OBSERVATIONS ON THE SPECIES OF THE NORTH PACIFIC.

By Frederick W. True,

HEAD CURATOR, DEPARTMENT OF BIOLOGY, U. S. NATIONAL MUSEUM.

INTRODUCTION.

Several years ago I began a study of the species of whalebone whales which frequent the western North Atlantic, with a view of ascertaining the facts regarding their distribution and migrations. I was confronted at once by the uncertainty in the nomenclature of the species frequenting European waters, with which the American forms were known to be closely allied, and my first undertaking was to ascertain the identity of the species described by Linnæus in the tenth edition of the Systema Naturæ. The results of this search for correct scientific names were published in 1898.[1]

Having fixed the names of the European species as far as possible, I next endeavored to locate the material on which the American species described by Cope and other cetologists had been based, and began a comparison of these types and of such other material as existed in the National Museum and other similar establishments in the United States with the European forms. For a considerable time I was so situated as to be unable to work on specimens, and during this period I collected from every available source records of the occurrence of whalebone whales on the Atlantic coast of North America, beginning with the very

[1] On the nomenclature of the whalebone whales of the tenth edition of Linnæus's Systema Naturæ. *Proc. U. S. Nat. Mus.*, 21, 1898, pp. 617–635, No. 1163.

earliest literature relating to the continent. It seemed probable that the investigation of the species themselves and of the records of their distribution could be carried on together and the results in both directions made ready for publication in one work. In this I have been disappointed. The work on the species has occupied a much longer time than was anticipated, and has made it necessary to defer the intimate study of the records of geographical distribution. It has seemed to me desirable, however, to publish with the discussion of the species a summary of the distribution records, so that in case the work originally projected cannot be completed by myself, the time of any subsequent investigator in this field may be economized.

It happened very opportunely while the study of the American species was in progress that a fishery for Finbacks and Humpbacks, similar to that carried on in Norway for many years, was established in Newfoundland. With the permission of the Secretary of the Smithsonian Institution I visited this fishery twice, and enjoyed the extraordinary facilities there afforded for the examination of fresh specimens of three species of baleen whales. No similar opportunity has, I believe, been open to American naturalists in the past.

Not only could the matter of species be investigated under favorable conditions, but a good opportunity was afforded for the study of individual variation among these huge animals, whereby the probabilities as to the validity of sundry nominal species could be satisfactorily estimated. The plates published herewith contain many photographic figures of different individuals of the same species, showing the extent of variation in color, form, etc. So far as I am aware, no similar figures from photographs have been published heretofore.

As nearly every cetologist takes occasion to say, the investigation of animals so large as whales is surrounded with peculiar difficulties. The physical labor involved in examining and turning about the massive bones and other parts is very fatiguing, and the mere weight of the specimens often thwarts the investigator.

In museums whale skeletons are commonly suspended from the roof so as to be practically inaccessible without the use of ladders and other unwieldy appliances, or the bones are stored in dark and dusty corners where they can be studied only with much begriming of note-books, hands, and clothes.

The size of the whalebone whales, the large expense involved in preparing specimens for scientific purposes, and the large amount of space such specimens occupy, render it improbable that extensive series of specimens will ever be assembled as is the practice nowadays with small mammals. Even if skeletons and casts were so assembled, they could not be compared one with another without the greatest difficulty. It follows that the methods of comparison which are employed advantageously in the case of small species can hardly be used here. Reliance must be placed instead on notes and photographs. So far as the exterior is concerned, there is a certain compensating advantage no doubt in the direct study of fresh specimens rather than of skins artificially prepared, though this applies only where conditions are at least approximately as good as they are at the Newfoundland stations. Many of the errors with which cetology is encumbered are due

to the observation of stranded specimens in various stages of decomposition, in which the natural appearance and relationships of parts were partially or entirely obscured.

Perhaps the greatest difficulty with which systematic cetology has to deal is the problem of individual variation. The extent to which individuals of the same species vary is enormous, and one unacquainted with this fact would be disposed to multiply species liberally, only to find after more extensive comparisons that the characters were slipping away. On account of the extraordinary individual variation in this group of mammals, and the peculiar character of the material, it would seem the part of wisdom to treat the matter of species conservatively. To a certain extent the absence of definite barriers in the ocean permits the whales to range more widely than is usual with land mammals, and on this account geographical races or sub-species are less likely to be formed. Still, from the observations of Scammon and others, it seems probable that species may in some cases be represented in the ocean by distinct herds, which are distinguishable by various peculiarities of size, form, proportion, and color. It is not certain, however, that these peculiarities may not be due to difference in sex and age.

In the study of these animals, the question obtrudes itself whether groups of individuals belonging to certain species when separated from the remainder of the species by the width of a continent, can and do continue to reproduce their kind for an indefinite period without change. To decide the question negatively on *a priori* grounds, as is the tendency to-day, is, I think, unscientific.

The present investigation, in so far as it reaches such questions, appears to support the view that detached groups of individuals of a species can perpetuate the characters of the species to which they belong for an indefinite period.

To find a difference and erect upon it a species, is far easier than to prove that this difference is merely an individual variation or age distinction. Furthermore, species once established, though based on very unsubstantial characters, often acquire a standing which no amount of criticism can affect. Such "species," it would seem, should have another name and be placed in a separate category. On the other hand, reluctance to accept species because they add to the length of the list, or to reduce them to synonymy without an examination of the material on which they are based, is to be decried. Between these two erroneous courses I have endeavored to steer in the present work.

I appreciate that the conclusions arrived at here are little more than a confirmation of opinions held by Van Beneden and some other masters of cetology, but with few exceptions these opinions regarding American whales were not based on the examination of American material. If I am not deceived, they proceeded rather from the *a priori* conclusion that it was not probable that other species existed than those frequenting European waters.

With the exception of the type of *Balæna cisarctica*, the types of the American species of Cope and Scammon are figured here from photographs for the first time. Cope intended to monograph his species, but never brought the work to completion.

The National Museum has incurred no small expense in obtaining the photographs of the types and other specimens, and I am also indebted to the following museum officials for courtesies, for which I desire to express my very sincere thanks: To Dr. S. G. Dixon, President of the Philadelphia Academy of Natural Sciences, and Mr. Witmer Stone, for assistance in locating the types of Cope's species and other interesting specimens, and permission to study and photograph them; to the proprietor of the Niagara Falls Museum, for permission to photograph and study the type of *Megaptera osphyia;* to the director of the Field Columbian Museum and Dr. D. G. Elliot, for photographs and measurements of the skeleton of *Balæna* in that museum; to Mr. H. H. Brimley, Curator of the State Museum, Raleigh, N. C., for assistance in measuring the skeleton of *Balæna* in that institution and for photographs; to the director of the American Museum of Natural History and Mr. Sherwood, for measurements and photographs of the *Balæna* skeleton in that museum; to Dr. Horace Jayne and Dr. Greenman, for assistance in measuring the fine skeleton of *Balænoptera* in the Wistar Institute, University of Pennsylvania, and permission to take photographs of it; to the director of the Museum of Comparative Zoölogy and Mr. Outram Bangs, for photographs of *Balæna*, and for other aid; to Prof. Geo. H. Ashley, for assistance in measuring the skeleton of *Balæna* in the Charleston College Museum, South Carolina; to Mr. F. A. Ward of Ward's Natural Science Establishment, Rochester, N. Y.

I wish to express appreciation also especially for the opportunities afforded me by the Cabot Steam Whaling Company of St. John's, Newfoundland, through the late Honorable A. W. Harvey, President of the Company, Mr. John Harvey, Secretary, Dr. A. Nielsen, Manager, and Captain Bull. Through the friendly co-operation of these gentlemen I was enabled to pursue my investigations under conditions which were quite exceptional. I also owe to Dr. L. Rissmüller a debt of gratitude for his enthusiastic forwarding of my desires in the matter of obtaining information and specimens. Mr. D. C. Beard permitted me to examine some interesting photographs and sketches of the *Balæna* figured in Holder's article on that genus; and Mrs. W. E. Crain allowed me to reproduce her valuable copyrighted photographs of a West Coast Humpback.

In regard to the system of measurements used in this work and the use of English rather than metric measures, a word is perhaps called for. In measuring whales at the Newfoundland stations, I adopted for the total length the distance from the tip of the upper jaw to the notch of the flukes, measured along the back. I adopted this for two reasons: first, because it gave rigid points from which to measure, and, second, because it is nearly impossible under ordinary circumstances to have a whale placed so as to be in exactly a straight line from head to flukes, and measuring between uprights is less expeditious than along the curves. Stranded whales are almost invariably measured in this way, and hence the measurements recorded in the literature can be more advantageously compared by employing the curvilinear total length rather than the rectilinear. The difference between the two is, in fact, much less than would be anticipated. In the tables included in this work, I have been obliged in some cases to cite lengths without knowing what

method was used. The difference is, I believe, immaterial where an average is drawn from a considerable number of specimens. It must be admitted that there is some uncertainty as to how to interpret the measurements of various observers, and I am fully conscious that the tables are not mathematically correct. Still, I am convinced that their inaccuracy is not such as to materially vitiate the result. The literature of cetology is in every language of western Europe, and the dimensions of specimens are similarly recorded in every variety of measure, such as Rheinland feet, old French feet, Spanish feet, Danish feet, Russian feet, and so forth. To avoid the great loss of time in converting all these measures to one system, I have reduced the dimensions in each instance to percentages of the total length. This has many advantages besides avoiding laborious calculations, which will be readily recognized. Where it has been necessary to cite actual measurements, I have reduced them all to English feet and inches, in the belief that for large dimensions this is preferable to employing the metric system. In the United States, at least, metric tapes for measurements up to 30 meters are not readily obtainable. All quoted matter is translated into English.

No attention has been paid to the Greenland Right whale, or Bowhead, *Balæna mysticetus*, in this connection, as no new material of value was available. The omission of this species is not especially important on account of the elaborate researches of Eschricht and Reinhardt, with which every cetologist is familiar.

CHAPTER I.

THE EARLIEST REFERENCES TO WHALEBONE WHALES IN AMERICAN WATERS.

The first reference to cetaceans in American waters is in the Saga of Thorfinn Karlsefne, giving an account of his voyage to Vinland. DeCosta's translation contains the following:

"Afterward a whale was cast ashore in that place [Stream Bay]; and they assembled and cut it up, not knowing what kind of whale it was. They boiled it with water; and ate it, and were taken sick. Then Thorhall said 'Now you see that Thor is more prompt to give aid than your Christ. This was cast ashore as a reward for the hymn which I composed to my patron Thor, who rarely forsakes me.' When they knew this, they cast all the remains of the whale into the sea and commended their affairs to God. From that time there was an abundance of food; and there were beasts on the land, eggs in the island, and fish in the sea."[1]

DeCosta gives this the date of 1008 A.D., and identifies Stream Bay with Buzzard's Bay, Mass. Beamish[2] has a note to the effect that "this whale was probably a species of the *Balœna physalis* of Linnæus, which was not edible, and being rarely seen in the Greenland and Iceland seas, was unknown to the Northmen." This is hardly probable as *Balœna physalus* of Linnæus is the common Finback of European waters and is edible. It may have been a bottlenosed whale of the genus *Hyperoödon*, the fat of which is purgative. The fact that the Northmen could throw the remains into the sea shows that it was not one of the large whales.

GREENLAND, DAVIS STRAIT, AND BAFFIN BAY.

The narrative of Iver Boty (or Burt), *maître d'hôtel* of the Bishop of Greenland, as quoted from the papers of Barents in Henry Hudson's possession, contains the following notice of whales:

"Item, from Skagen Ford east lyeth a hauen called Beare Ford: it is not dwelt in. In the mouth thereof lyeth a riffe [reef], so that great ships can not harbour in it.

"Item, there is great abundance of whales; and there is a great fishing for the killing of them there, but not without the bishop's consent, which keepeth the same

[1] DeCosta, B. F., The Pre-Columbian Discovery of America by the Northmen, 2d ed., 1890, pp. 125–126.

[2] Beamish, N. L., Discovery of America by the Northmen, 1841, p. 91, foot-note.

for the benefit of the cathedrall church. In the hauen is a great swalth[1]; and when the tide doth runne out, all the whales doe runne into the sayd swalth."[2]

Boty's account is of course pre-Columbian, and as it is supposed to relate to the most flourishing period of the Norse colonies in Greenland, we may properly consider that the events mentioned in it occurred in the 12th century. Whatever the fact as regards the date of this observation, we may well doubt that the whales referred to were whalebone whales. It is much more probable that they were white whales, *Delphinapterus*.

Passing on to the times of Columbus and the great discoverers and explorers, the earliest bit of information about the larger whales of Greenland which I find is in Beste's narrative of Martin Frobisher's third voyage to Davis Strait in 1578. An odd accident happened to one of the vessels in his fleet, which is thus described:

[1578. FROBISHER'S THIRD VOYAGE.]

"On Monday, the laste of June [1578], wee mette with manye greate whales, as they hadde beene porposes.

"This same day the *Salamander* being under both hir corses and bonets, hapned to strike a greate whale with hir full stemme, wyth such a blow, that the ship stoode stil and stirred neither forwarde nor backward. The whale thereat made a great and ugly noise, and caste up his body and tayle, and so went under water, and within two dayes after there was founde a greate whale dead, swimming above water, which we supposed was that the *Salamander* stroke."[3]

The place where this happened must have been just east of Frobisher Bay, the entrance to which (Queen Elizabeth's Foreland[4]) they sighted July 2d.

It is somewhat singular that there is no vessel named *Salamander* in the roster of the fleet. As there is a *Salomon* or *Sollomon*, however, it is probable that the name is misspelt in the paragraph quoted above.

From the expression "greate whales, *as they hadde beene porposes*," in the first sentence, it might be inferred that the *Salomon* ran against an *Orcinus* or *Hyperoödon*, rather than a baleen whale, but it seems hardly probable that either of these could stop a vessel of above 130 tons under full sail. Furthermore, I presume it

[1] An eddy, or whirlpool.

[2] A Treatise of Iver Boty a Gronlander, etc. In Asher's Henry Hudson the Navigator (Hakluyt Society, 1860, p. 231). From Purchas His Pilgrimes, v, 3, pp. 518–520. Writings of William Barentz in Hudson's possession.

The complete heading of the narrative is as follows: "A Treatise of Iver Boty a Gronlander, translated out of the Norsh language into High Dutch, in the yeere 1560. And after out of High Dutch into Low Dutch, by William Barentson of Amsterdam, who was chiefe Pilot aforesaid [of the expedition of 1595 to the Northeast]. The same copie in High Dutch is in the hands of Iodocvs Hondivs, which I haue seene. And this was translated out of Low Dutch by Master William Stere, Marchant, in the yeere 1608, for the vse of me Henrie Hudson. William Barentsons Booke is in the hands of Master Peter Plantivs, who lent the same vnto me."

[3] The Three Voyages of Martin Frobisher. Ed. by R. Collinson. Hakluyt Soc., 1867, p. 234. Reprinted from the 1st ed. of Hakluyt's Voyages.

[4] Or Cape Resolution, Resolution Island.

is not necessary to suppose that the "greate whale" which was struck was of the same sort as those referred to as resembling porpoises. These early narratives usually contain no more than a passing word regarding the animals observed and anything like satisfactory identifications are impossible.

From the accounts of the voyages of John Davis to the strait which bears his name we are able to get a little better idea of the whales which were encountered.

In the narrative of his first voyage to Greenland in 1585, is the following note:

"Between the 16th and the 18th [of July, 1585] great numbers of whales were also seen."[1]

This was just before Davis made a landfall at Cape Discord on the east coast of Greenland, which he sighted on July 20, 1585. Soon afterwards he passed into Davis Strait and crossed to the vicinity of Cumberland Sound, where, according to the narrative written by John Janes, the following incidents occurred:

[1585. DAVIS'S FIRST VOYAGE.]

"The 17 [of August, 1585] we went on shoare [in Cumberland Sound] . . . Our Captaine and master searched still for probabilities of the [Northwest] passage, and first found, that this place was all Islands, with great sounds passing betweene them. . . . Thirdly, we saw to the west of those Isles, three or foure Whales in a skul, which they judged to come from a westerly sea, because to the Eastward we saw not any whale. Also as we were rowing into a very great sound lying southwest [Irvine Inlet ?—ED.], upon a suddayne there came a violent counter checke of a tide from the southwest against the flood which we came with, not knowing from whence it was maintayned."[2]

Davis was at this time, as the narrative shows, exploring Cumberland Sound with the hope of finding the much-sought Northwest Passage. We may suppose that the whales seen there were either Humpbacks or Finbacks; though from lack of a description it is impossible to determine which of the two they were. The Greenland whale is not in these parts in August.

In the narratives of Davis's third voyage to Greenland in 1587 we find other allusions to whales, as follows:

"The 24 [of June, 1587] being in 67 degrees and 40 minutes, we had great store of Whales, and a kinde of sea birdes which the Mariners called Cortinous [probably a misprint.—ED.]."[3]

This was in Davis Strait opposite the Cumberland peninsula. The kind of whale, as before, is uncertain. It may have been the Beluga.

Another allusion, about a month later, is as follows:

"As we rode at anker [July 23, 1587, among the islands "in the bottome"

[1] Voyages toward the Northwest. Ed. by Thos. Rundall. Hakluyt Society, 1849, p. 36.

[2] The Voyages and Works of John Davis the Navigator. Ed. by A. H. Markham. Hakluyt Soc., 1880, pp. 12–13.

[3] *Op. cit.*, p. 43.

of Cumberland Sound] a great whale passed by us, and swam west in among the isles."[1]

Twenty years later Henry Hudson was in Greenland waters, seeking like his predecessors that *ignis fatuus*, the Northwest Passage to Cathay. In the narratives of his voyages there are occasional references to whales. The earliest of these, in the narrative of the first voyage in 1607, is as follows:

[1607. HUDSON'S FIRST VOYAGE.]

"Also wee saw [June 13th] a whale close by the shoare. Wee called the head-land which we saw Youngs Cape; and neere it standeth a very high mount, like a round castle, which wee called the Mount of Gods Mercie."[2]

This place appears to have been in Hudson Strait. A few days later we find another reference:

"This day [June 18, 1607] we saw three whales neere our ship, and having steered away north-east almost one watch, five leagues, the sea was growne every way."[3]

This appears to have been on the east coast of Greenland. Finally, in that narrative of Hudson's last voyage, by Prickett, which contains the tragic story of his fate, we find another mention of whales, as follows:

[1610. HUDSON'S FOURTH AND LAST VOYAGE.]

"Our course [soon after the 4th of June, 1610] for the most part was betweene the west and north-west, till we raysed the Desolations, which is a great iland in the west part of Groneland. On this coast we saw store of whales, and at one time three of them came close by us, so as wee could hardly shunne them: then two passing very neere, and the third going under our ship, wee received no harme by them, praysed be God."[4]

This locality was in the vicinity of Cape Farewell, the "Desolations" being on either side of that cape. In the perusal of this account one is reminded very forcibly of Scammon's description of the habits of the Common Finback of the North Pacific, *Balænoptera velifera* Cope. "It frequently gambols about vessels at sea," he writes, "in mid-ocean as well as close in with the coast, darting under them or shooting swiftly through the water on either side, at one moment upon the surface, belching forth its quick ringing spout, and the next instant submerged deep beneath the waves."[5]

Close after Hudson follows Baffin, who was pilot of the ship *Discovery* for the company for the discovery of the Northwest Passage, and approached the Green-

[1] Voyages toward the Northwest. Ed. by Thos. Rundall. Hakluyt Soc., 1849, p. 47. Davis's Traverse Book. From Hakluyt, 3, pp. 153, 154.

[2] Henry Hudson, the Navigator. Ed. by Geo. Asher. Hakluyt Soc., 1860, p. 3.

[3] *Op. cit.*, p. 4.

[4] *Op. cit.*, p. 99.

[5] *Proc. Acad. Nat. Sci. Phila.*, 1869, p. 52.

land coast in May, 1612. The record for the 12th day of that month contains the following note:

[1612. BAFFIN'S FIRST RECORDED VOYAGE.]

"This day [May 12, 1612] the water changed of a blackish colour; also, we saw many whales and grampus's."[1]

This was near (and east of) Cape Farewell, which they sighted May 13th, and again May 14th. In 1616, in the same month, Baffin was once more in Greenland waters, and the narrative of that voyage contains an interesting account of the finding of a dead whale in Davis Strait somewhat north of Disco Island. Baffin records the incident thus:

[1616. BAFFIN'S SECOND VOYAGE TO GREENLAND. (FIFTH RECORDED VOYAGE.)]

"The two and twentieth day [of May, 1616], at a north sunne, wee set saile and plyed still northward, the winde being right against vs as we stood off and on. Vpon the sixe and twentieth day, in the afternoone, we found a dead whale, about sixe and twentie leagues from shoare, hauing all her finnes [whalebone]. Then making our ship fast, wee vsed the best means wee could to get them, and with much toile got a hundred and sixtie that euening. The next morning the sea went uery high, and the winde arising, the whale broke from vs, and we were forced to leaue her and set saile, and hauing not stood past three or foure leagues north-westward, came to the ice, then wee tacked and stood to the shoare-ward, a sore storme ensued."[2]

This dead whale is mentioned again in a letter which Baffin wrote to Sir John Wolstenholme, one of the principal promoters of the enterprise, in connection with quite extended remarks on the whales of Baffin Bay, so that we are enabled to identify it as a Greenland Right whale. The paragraphs which are pertinent to our subject are as follows:

[1616. BAFFIN'S LETTER TO SIR JOHN WOLSTENHOLME.]

"Now that the worst is knowne (concerning the passage) it is necessarie and requisite your worship should vnderstand what probabilitie and hope of profit might here be made hereafter, if the voyage might bee attempted by fitting men. And first, for the killing of whales; certaine it is, that in this Bay [Baffin Bay] are great numbers of them, which the Biscayners call the *Grand Bay whales*, of the same kind as are killed at *Greeneland*, and as it seemeth to me, easie to be strooke, because they are not vsed to be chased or beaten. For we being but one day in Whale Sound (so called for the number of whales we saw there sleeping, and lying aloft on the water, not fearing our ship, or ought else); that if we had beene fitted with men and things necessarie, it had beene no hard matter to haue strooke more then would have made three ships a sauing voyage; and that it is of that sort of whale, theare is no feare; I being twise at Greeneland, tooke sufficient notice to know them againe; besides a dead whale we found at sea, hauing all her

[1] The Voyages of William Baffin. Ed. by C. R. Markham. Hakluyt Soc., 1881, p. 7. From Churchill's Collection of Voyages and Travels, 6, 1732, pp. 241–251. Written by John Gatonbe.

[2] *Op. cit.*, pp. 139–140. From Purchas. Written by Baffin.

finnes (or rather all the rough of her mouth), of which with much labour we got one hundred and sixtie the same evening we found her; and if that foule wether and a storme the next day had not followed, we had no doubt but to haue had all, or the most part of them: but the winde and sea rising, shee broke from vs, and we were forced to leave her. Neither are they onely to be looked for in Whale Sound, but also in Smith's Sound, Wolstenholme's Sound, and others, *etca.*," . . . (Pp. 146–147.)

"As concerning what the shore will yeeld, as beach-finnes, morse-teeth, and such like, I can say little, because we came not on shore in any of the places where hope was of findinge them.

"But here som may object why we sought that coast no better? To this I answere, that while we were thereabout, the wether was so exceeding foule, we could not. . . . When we had coasted the land so farre to the southward, that hope of passage was none, then the yeere was too farre spent [to seek a harbor], and many of our men very weake, and withall we hauing some beliefe that ships the next yeere would be sent for the killing of whales, which might doe better than we." (Pp. 147–148.)

"And seeing I have briefly set doune what hope there is of making a profitable voyage, it is not vnfit your worship should know what let or hindrance might be to the same. The chiefest and greatest cause is, that som yeere it may happen by reason of the ice lying betweene 72 and a halfe and 76 degrees, no minutes, that the ships cannot com into those places till toward the middest of July, so that want of time to stay in the countrey may be some let: yet they may well tarry till the last of August, in which space much businesse may be done, and good store of oile made. Neuerthelesse, if store of whales come in (as no feare to the contrarie) what cannot be made in oyle, may be brought home in blubber, and the finnes will arise to good profit. Another hinderance will be, because the bottome of the sounds will not be so soone cleere as would bee wished; by meanes whereof, now and then a whale may be lost. (The same case sometimes chanceth in *Greeneland* [*i. e.* Spitzbergen].) Yet, I am perswaded those sounds before named [Whale, Smith, and Wolstenholme] will all be cleere before the twentieth of July: for we, this yeere, were in Whale Sound the fourth day, amongst many whales, and might have strooke them without let of ice."[1]

This letter, which is undated, relates to the second voyage, 1616.

The use of the name "Grand Bay whale" in this letter for the Greenland Right whale attracted the attention of Eschricht and Reinhardt, and they enter into an elaborate discussion as to its significance in relation to the primitive distribution of the species in their exhaustive memoir.[2]

Thomas Edge was in Spitzbergen at the same time as Baffin, and in the narrative of his "ten several voyages" thither he takes pains to insert a description of the various species of whales found in those waters. The description begins thus:

[1610–1622. VOYAGES OF THOMAS EDGE TO SPITZBERGEN.]

"There are eight sorts of whales: The first is called the *Grand-Bay*, from a place in *New-found-land*, where they were first killed; he is black, with a smooth

[1] Voyages towards the Northwest. Ed. by Thos. Rundall. Hakluyt Soc., 1849, pp. 146–149. From Purchas.

[2] Om Nordhvalen. *Vidensk. Selsk. Skr., 5 Række, naturvid. og math. Afd.*, Bd. 5, p. 459.

Skin, and white underneath the Chaps: This Whale yields about 100 Hogsheads of Oyl.

"The second is called *Sarda*, of the same colour, but somewhat less, and yields about 70 or 80 Hogsheads; he hath white things growing on his Back like to Barnacles."[1]

Edge thus corroborates Baffin, and there can be no doubt that the name "Grand Bay whale" was in currency for *Balæna mysticetus* at the beginning of the seventeenth century and perhaps earlier.

Grand Bay, as the maps of that period show, was a name applied to that part of the Gulf of St. Lawrence immediately within the Strait of Belle Isle. It is to be found on Allefonsce's sketch, Champlain's maps (1612, 1613, and 1632), Jacobsz's map (1621), and others.[2]

Now, although the latest writer on the Greenland whale places the southern limit of its range at about 58° n. lat., on the coast of Labrador,[3] one would not be surprised to learn that in the winter months it followed the ice down to the Strait of Belle Isle, and became the object of a fishery there. But, as Eschricht remarked, the Newfoundland whale fishery of the sixteenth and seventeenth centuries was carried on exclusively in the summer months and on the theory that the Greenland whale was one of the species pursued, it is necessary to suppose that it remained after the ice had disappeared in these parts, which is entirely contrary to what is known of its habits.

As a solution of the problem, Eschricht suggested that the Basques did not know of the visits of the Greenland whale to the Newfoundland coast until they had begun to establish settlements and winter there. In the instructions given Edge by the Muscovy Company the species is called the "Bearded whale"; while in his account of his voyages to Spitzbergen, 1612 to 1622, it is called "Grand Bay" whale. The natural inference is that soon after 1611 certain Basques had discovered that the Greenland whale occurred in Newfoundland waters, and had afterwards shipped with Edge for the Spitzbergen fishery and reported to him the name "Grand Bay" whale. The matter quoted is chiefly interesting in the present connection as the first attempt to identify the whales in American waters with those of Europe, and as an early (though not the earliest) mention of whales at Newfoundland.

A little later in this same voyage which we have been discussing, Baffin

[1] Harris's Voyages, 1, p. 574. Purchas, His Pilgrimes, 3, 1625, pp. 462–473.

Champlain has the following regarding the name of "Grand Baye":

"Il y a un lieu dans le golphe Sainct Laurent, qu'on nomme la grande baye, proche du passage du Nort de l'Isle de terre neufue, à cinquante deux degrés, ou les Basques vont faire la pesche des balaines."

(Laverdière, Œuvres de Champlain, 2d ed., 1870, 6, p. 1088. This is in the second part of Les Voyages de la Nouvelle France Occidentale, dicte Canada. Paris, 1632.)

[2] See Justin Winsor's Cartier to Frontenac, 1894, pp. 42, 102, 107, 125, and 140, where these maps are reproduced.

[3] Southwell, Thos., The Migration of the Right Whale (*Balæna mysticetus*). *Nat. Sci.*, 12, 1898, pl. 12.

proceeded to very high latitudes and on July 3d, 1616, was in Wolstenholme Sound, to which he gave its present name. He writes thus of the whales:

[July 3, 1616]: "This Sound wee called Wolstenholme Sound; it hath many inlets or smaller sounds in it, and is a fit place for the killing of whales."[1]

The next day he explored and named Whale Sound, of which he writes:

"In this Sound [July 4, 1616] we saw great numbers of whales, therefore we called it Whale Sound, and doubtlesse, if we had beene provided for killing of them, we might have strooke very many. It lyeth in the latitude 77° 30′."[2]

HUDSON BAY.

The narratives of Hudson's (1610), Baffin's (1612–1616), Button's (1612), and Munck's (1619) voyages contain nothing regarding whales in Hudson Bay and Strait. A passing reference is to be found in the account of Fox's voyage of 1631, as follows:

[1631. CAPTAIN LUKE FOX IN HUDSON BAY.]

"Fox obeyed his instructions, though he evidently entertained an opinion that this [*i. e.*, Roe's Welcome northward] was the fittest part to search for the passage; 'being moved by the high flowing of the tyde and the *whales*, for all the tydes that floweth that bay [Hudson Bay], commeth (neere) from thence.'"[3]

Captain Coats's Remarks on the Geography of Hudson's Bay, from voyages between 1727 and 1751, contains the following:

"Near Whale Cove and Brook Cobham, it is agreed on all hands, their are such sholes of whales and seales, as is no where else to be met with in the known world."[4]

NEWFOUNDLAND AND THE GULF OF ST. LAWRENCE.

It is sometimes asserted that the Basques, who undoubtedly hunted the Right whale, *Balæna biscayensis*, on the coasts of Europe in the Middle Ages, finally crossed to Newfoundland in pursuit of their quarry at a period antedating Columbus's discovery. Thus, P. Fischer in 1872, in his account of the Basque whale fishery, writes: "When the Basques had destroyed the whales which arrived in

[1] The Voyages of William Baffin, 1612–1622. Ed. by C. R. Markham. Hakluyt Soc., 1881, p. 144. From Purchas. Written by Baffin.

[2] *Op. cit.*, p. 145. Ross also found whales in this vicinity in 1818, but Southwell regards both these instances as exceptional, and thinks it improbable that the Greenland whale (*B. mysticetus*) commonly passes beyond 75° n. lat. (*Nat. Sci.*, 12, 1898, p. 408.)

[3] Voyages towards the Northwest. Ed. by Thomas Rundall. Hakluyt Soc., 1849, p. 177. Abst. from N. W. Foxe.

[4] Hakluyt Soc., 1852, p. 29.

winter in their parts, they sailed westward, and in 1372 reached the banks of Newfoundland, where they observed whales in abundance."[1]

No authorities are cited by Fischer, and similar statements by other authors prove elusive. Justin Winsor summed up the evidence on this point in 1894 in the following language:

"We need not confidently trust the professions of Michel and other advocates of the Basques, and believe that a century before Cabot their hardy fishermen discovered the banks of Newfoundland, and had even penetrated into the bays and inlets of the adjacent coasts. There seems, however, little doubt that very early in the sixteenth century fishing equipments for these regions were made by the Normans, as Bréard chronicles them in his *Documents relatifs à la Normand*."[2]

Of post-Columbian explorers of Newfoundland and the St. Lawrence, the first to make mention of large whales is Cartier. Indeed, the allusions to cetaceans in his narrative of his second voyage to Canada appear to constitute the first authentic notice of whalebone whales on the east coast of North America. Cartier left St. Malo on his second voyage, May 19, 1535, and in July entered the Gulf of St. Lawrence. Soon afterwards he passed westward and proceeded to explore the St. Lawrence River. In his narrative of the journey we find the following:

[1535. CARTIER'S SECOND VOYAGE.]

"The said river [the St. Lawrence] beginneth beyond the Island of the Assumption, over against the high mountains of Hognedo, and of the seven islands: the distance over from one side to the other is about 35 or 40 leagues: in the midst it is above 200 fathom deep. The surest way to sail upon it is upon the south side; and toward the north, that is to say, from the said seven islands, from side to side there is seven leagues distance, where are also two great rivers that come down from the hills of Saguenay, and make divers very dangerous shelves in the sea.

"At the entrance of those two rivers, we saw many a great store of whales and sea-horses."[3]

Exactly where these two rivers are is uncertain, but early maps show the 'Land of the Seven Islands" to be on the north shore of the St. Lawrence, near its mouth. The whales mentioned were most probably whalebone whales, as mention is made soon afterwards of porpoises and the Beluga, thus:

"All the said country on both sides the [St. Lawrence] river, as far as Hochelay and beyond, is as fair and plain as ever was seen. . . . There are also many whales, porpoises, sea-horses, and adhothuis [Beluga], which is a kind of fish that we had never seen nor heard of before.

[1] FISCHER, P., Documents pour servir à l'Histoire de la Baleine des Basques (*Balæna biscayensis*). *Annal. Sci. Nat., Zoöl.*, 15, 1872, art. 3, p. 15.

Van Beneden repeats the statement in his Hist. Nat. des Cétacés des Mers d'Europe, 1889, p. 25.

[2] WINSOR, JUSTIN, Cartier to Frontenac, 1894, pp. 9–10.

[3] Narration of the Navigation to the Islands of Canada, etc. Pinkerton's Voyages, 12, p. 657. Cartier's Voyage, 1535. From Hakluyt, 3, p. 212.

"They are as great as porpoises, as white as any snow, their body and head fashioned as a greyhound, they are wont always to abide between the fresh and salt water, which beginneth between the river of Saguenay and Canada."[1]

At the date of Cartier's explorations (and even somewhat before his time) whalers are believed to have pursued the Biscay whale, *Balæna biscayensis*, in the Gulf of St. Lawrence. The records of this industry are for the most part buried in obscurity, or have been destroyed, and such as are now known contain no descriptions of whales. Eugen Gelcich, in an article on Duro's Disquisiciones Nauticas, writes:

"The regular appearance of the whale in the Bay of Biscay at the beginning of autumn and its disappearance with the first breath of spring must have been noticed very early by the Gascognes. Whether it occurred to any one, however, as early as the 10th century to follow the whale opportunely with its departure, in order to discover its summer station, is not demonstrable, although a tradition relative thereto existed in Spain, and perhaps still exists. Vargas Ponce [a celebrated Spanish historian] in spite of the most diligent search found only records since the year 1530. These were in the municipal and parochial records of Brio. The names of the caravels as well as of their commanders are given. The celebrated Spanish admiral, Juan de Urdaire, began his maritime career in such voyages, which reached to the American coasts."[2]

Later in the century we have the statement made by Anthony Parkhurst in a letter to Hakluyt, in 1578, to the effect that at that time from 20 to 30 Basque whaling vessels repaired to Newfoundland "to kill whale for Traine."[3]

For the year 1587, we have the following reference in the narrative of Davis's third voyage:

"The 17th [of August, 1587] we met a shippe at Sea, and, as farre as wee could judge, it was a Biskaine: wee thought she went a fishing for Whales, for in 52 degrees or thereabout, we saw very many."[4]

His Traverse Book at this date contains the following:

"The true course, &c. This day, upon the Banke [Grand Bank of Newfoundland] we met a Biscaine bound either for the Grand bay or for the passage. He chased us."[5]

[1] Narration of the Navigation to the Islands of Canada, etc. Pinkerton's Voyages, 12, p. 658.

"Aug. 18, 1535, the sailors saw more whales near Anticosti Id. than they could remember ever to have seen before." (Eschricht, from Marc Lescarbot's Histoire de la nouvelle France, 4th ed., 1624, p. 285.)

[2] Gelcich, E., Der Fischfang der Gascogner und die Entdeckung von Neufundland. Nach den "Disquisiciones Nauticas" von Cæsaro Fernandez Duro bearbeitet. *Zeit. Gesell. Erdkunde*, Berlin, 18, 1883, p. 258.

[3] Hakluyt, The Principal Navigations of the English Nation, 3, 1600, p. 132.

[4] The Voyages and Works of John Davis. Ed. by A. H. Markham. Hakluyt Soc., 1880, p. 48.

[5] *Op. cit.*, p. 57. Davis started Aug. 15th at noon in lat. 52° 12′ and 16 leagues from shore, and in the next 44 hours went 80 leagues about E. by S.

Edward Haies, in his account of Sir Humphrey Gilbert's voyage to Newfoundland in 1583, includes among the "commodities" of the island "abundance of whales," "for which also," he writes, "is a very great trade in ye bayes of Placentia and Grand bay, where is made Trane oyles of the whale."[1]

Toward the close of the century, in 1594, the ship *Grace of Bristoll* made a trip to the Gulf of St. Lawrence for whales and reported finding some 700 or 800 pieces of whalebone in two large Basque whaling vessels which had been wrecked in St. George's Bay, Newfoundland. The account, in Hakluyt's Voyages, is as follows:

[1594. VOYAGE OF THE "GRACE OF BRISTOLL" TO THE BAY OF ST. LAWRENCE.]

"In this bay of Saint George [Newfoundland, May, 1594] we found the wrackes of 2 great Biskaine ships, which had bene cast away three yeres before: where we had some seven or eight hundred whale finnes, and some yron bolts and chains of their mayne shrouds & fore shroudes: al their traine [oil] was beaten out with the weather but the caske remained still. Some part of the commodities were spoiled by tumbling downe of the cliffs of the hils, which covered part of the caske, and greater part of those whale finnes, which we understood to be there by foure Spaniards which escaped & were brought to S. John de Luz. . . .

"Then being enformed, that the Whales which are deadly wounded in the grand Baye [near the Strait of Belle Isle], and yet escape the fisher for a time, are woont usually to shoot themselves on shore on the Isle of Assumption, or Natiscotec, which lieth in the very mouth of the great river that runneth up to Canada, we shaped our course over to that long Isle of Natiscotec. . . .

"And after wee had searched two dayes and a night for the whales which were wounded which we hoped to have found there, and missed of our purpose we returned backe to the Southwarde."[2]

In 1594 or 1595, Robert Dudley made a voyage to the West Indies, returning along the coast of the United States and Canada. On April 11, 1595, the following was recorded:

"After wee weare past the meridian of the Bermudes our courses brought us not far from the cost of Labradore or Nova Francia, which wee knew by the great aboundance of whalles."[3]

Lescarbot, who took part in the establishment of the French colonies in Acadia and Port Royal in 1605, published in 1609 a history of the region, in the course of which he describes the whale fishery in the Gulf of St. Lawrence, though he does not describe the whale itself. This, however, was doubtless the Right whale. He remarks:

[1609. LESCARBOT'S NARRATIVE.]

"I leaue the maner of taking of her [Leviathan], described by *Oppian* and *S. Basil* for to come to our French-men, and chiefely the Basques, who doe goe euery

[1] HAKLUYT, R., The Principal Navigations of the English Nation, 1589, p. 689.

[2] *Op. cit.*, 3, 1600, p. 194. The voyage of the *Grace* of Bristol of M. *Rice Fones*, a Barke of thirty-five Tunnes, vp into the Bay of Saint *Laurence* to the Northwest of *Newefoundland*, as farre as the Isle of *Assumption* or *Natiscotec*, for the barbes or fynnes of Whales and traine oyle, made by *Silvester Wyet*, Shipmaster of *Bristoll*.

[3] The Voyage of Sir Robert Dudley to the West Indies, 1594–1595. Hakluyt Soc., 1899, p. 53.

yeare to the great riuer of *Canada* for the Whale. Commonly the fishing thereof is made in the riuer called *Lesquemin* toward *Tadoussac*. And for to doe it they goe by skowtes to make watch vpon the tops of rockes, to see if they may haue the sight of some one: and when they haue discovered any, foorthwith they goe with fower shaloupes after it, and hauing cunningly borded her, they strike her with a harping iron to the depth of her lard, and to the quicke of the flesh. Then this creature feeling herselfe rudely pricked, with a dreadfull boisterousnesse casteth herselfe into the depth of the sea. The men in the meane while are in their shirts, which vere out the cord whereunto the harping iron is tied, which the whale carrieth away. But at the shaloupe side that hath giuen the blow there is a man redy with a hatchet in hand to cut the said cord, least perchance some accident should happen that it were mingled, or that the Whales force should be too violent: which notwithstanding hauing found the bottome, and being able to goe no further, she mounteth vp againe leasurely aboue the water: and then againe she is set upon with glaue-staves, or pertuisanes, very sharp, so hotly that the salt-water pierceing within her flesh she looseth her force, and remaineth there. Then one tieth her to a cable at whose end is an anker which is cast into the sea, then at the end of six or eight daies they goe to fetch her, when time and opportunity permits it they cut her in peeces, and in great kettles doe seeth the fat which melteth it selfe into oile, wherewith they may fill 400 Hogs-heads, sometimes more, and sometimes lesse, according to the greatnesse of the beast, and of the tongue commonly they draw fiue, yea six hogs-heads full of traine." [Then follows quotation from Acosta's account of Indians taking whales in Florida.][1]

When Champlain was returning from Tadoussac on the St. Lawrence River to France, 1610, his vessel ran into a whale and he takes the occasion to describe the whale fishery in detail, as follows:

[1610. CHAMPLAIN'S DESCRIPTION OF THE WHALE FISHERY IN NEW FRANCE, CHAPTER XII.]

"It has seemed to me not to be inappropriate to give here a short description of the whale fishery, as many persons have never seen it and believe that they are taken by shooting with guns, while there are liars so unblushing that they affirm this to those who know nothing of it. From these false accounts many persons have obstinately disputed this with me.

"Those then who are most skilful at this fishery are the Basques, who in order to prosecute it, place their vessels in a safe harbor, near where they judge there are numbers of whales, and equip many boats filled with good men and lines, which are small ropes made of the best hemp obtainable, having a length of at least 150 fathoms; and have a great many lances of the length of a half-pike, which have the iron six inches broad,—of others a foot and a half or two feet long, very sharp. They have in each boat a harpooner, who is a man of the most agile and skilful among them, and draws the most pay after the masters, inasmuch as it is the most hazardous position. The boat above mentioned being outside the harbor, they look in all directions in order that they may if possible see and discover a whale feeding off one shore or the other; and not seeing any, they return to land and ascend the highest promontory they find, for the purpose of seeing as far as possible, and there they station a man as a sentinel, who seeing a whale, which they discover as much by its size as by the water which it spouts out of its blowholes, which is more than

[1] LESCARBOT, Nova Francia, Or the Description of that part of New France which is one continent with Virginia, &c. Trans. by P. E. London, 1609, pp. 268–269.

a barrel at a time, and to the height of two lances; and from this water which it spouts up, they judge how much oil it will probably yield. There are some from which as much as 120 (*six vingts*) barrels may be obtained, from others less.

"On seeing this huge fish, they embark promptly in their boats and by force of oars or wind, go as close as they may. Seeing the whale between two waves, at the same instant the harpooner is at the front of the boat with a harpoon, which is an iron 2 feet long and one half broad at the wings, hafted on a staff the length of a half-pike, at the middle of which there is a groove where the line is attached; and as soon as the harpooner sees his chance, he throws his harpoon at the whale, the same entering well forward. As soon as it (the whale) feels itself wounded, it goes to the bottom. And if by chance on returning a number of times, it assaults the boat or the men with its tail, it shatters them like a glass.

"This is all the risk they run of being killed in harpooning it. But as soon as they have cast the harpoon, they let their line run out, till the whale is at the bottom; and sometimes as it does not go down directly, it tows the boat more than eight or nine leagues, and goes as fast as a horse, and the men are very often compelled to cut their line, fearing that the whale may drag them under the water. But when it goes directly to the bottom it remains there a little time & then returns quietly to the surface; and as fast as it rises, they take in their line little by little, and then when it is on top they place two or three boats around it with their lances, with which they give it many thrusts; and feeling itself struck the whale descends directly below the surface, losing blood & becoming enfeebled in such a manner that it has no more strength nor vitality, and coming again to the surface, they succeed in killing it. When it is dead, it does not go down to the bottom again; and then they fasten to it good ropes and tow it ashore, in the place where they have their try works (*degrat*), which is the place where they boil the blubber of the whale in order to extract the oil.

"Such is the manner in which they fish and not by shooting with guns, as many think, as I have said above."[1]

This is repeated from Les Voyages du Sieur de Champlain, Paris, 1613, p. 226 (Laverdière, Œuvres de Champlain, 2d ed., 3, 1870, p. 374), where it occurs in connection with the voyage from Tadoussac to France in 1610; but in the latter place it is introduced thus:

"On the 13th of the said month we departed from Tadoussac, and arrived at the Isle Percée the next day, where we found a number of vessels engaged in the fishery for dry and fresh fish.

"On the 18th of the said month we departed from Isle Percée and passed along the 42^{d} parallel of latitude without having any knowledge of the great bank where the fishery for fresh fish is carried on, for the said place is too narrow on this parallel.

"Being half across, we ran into a whale which was asleep and the vessel passing above it made a very large opening in it near the tail, which caused it immediately to wake (without our vessel being damaged) and shed a great amount of blood.

"It seems to me not inappropriate to give here a brief description of the whale fishery," etc.

[1] Laverdière, Œuvres de Champlain, 2d ed., 5, 1870, pp. 835–837. This is Chapter XII in Les Voyages de la Nouvelle France Occidentale, dicte Canada, faits par le Sr. de Champlain. Paris, 1632.

At the close Champlain remarks as follows:

"To take up again the thread of my discourse, after the wounding of the whale, as aforesaid, we took numbers of porpoises which our boatswain's mate harpooned, from which we received pleasure and satisfaction."[1]

From the fact that the whales mentioned by Champlain remained on the surface when killed it is evident that they were Right whales, and not Finbacks, or Humpbacks, as indeed we know from other sources.

The branch of the Franciscan monks of the Roman Catholic church known as the Recollets had mission establishments on the St. Lawrence from 1615 to 1629. Sagard-Theodat, a monk of this order, published in 1632 an account of his observations in the country, in the course of which he makes some very interesting observations on the whales of the Gulf of St. Lawrence, which are among the earliest sufficiently detailed to indicate the kind of whale referred to. He writes:

[1615–1629. SAGARD-THEODAT'S NARRATIVE.]

"I amused myself at times, when I felt so disposed, by watching the whales spout and the little whales play, and have seen an infinity of them, particularly at Gaspé, where they disturbed our repose by their puffing, and the divers cruisings of both *Gibars* and whales. The *Gibar* is a kind of whale, so called on account of a protuberance that it seems to have, having the back much raised, where it carries a fin.

"It is not smaller than the whales, but is not so thick or corpulent, and has the snout longer and more pointed, and a blowhole on the forehead, through which it spouts water with great force. Some on this account call it the puffer.

"All the whales carry and produce their young fully alive, nursing them, and covering and shielding them with their fins. The *Gibars* and other whales sleep holding their heads extended a little out of the water, so that this blowhole is exposed and at the surface. The whales are to be seen and discovered from afar by their tail, which they show frequently on diving into the sea, and also by the water which they throw out of their blowholes, which is more than a hogshead at a time, and to the height of two lances, and by this water which the whale throws up, one can judge how much oil it will furnish.

"There are such as one may obtain more than 400 hogsheads (*barriques*) from, and others less, and, from the tongue one may ordinarily obtain five or six hogsheads (and Pliny states that whales are found which are 600 feet long and 360 broad). There are some from which one may obtain more.

"On my return I saw very few whales at Gaspé, in comparison with the preceding year, and could not perceive the cause, nor the reason for it, if not that it might be in part the great abundance of blood which flowed from the wound of a large whale, that for pleasure one of our commissioners had given him with a shot of an arquebus, double loaded. This is, however, not the way to capture them, for it requires quite other inventions, and artifices of which the Basques know very well how to make use, but since other authors have written of them, I will refrain from describing them.

[1] LAVERDIÈRE, Œuvres de Champlain, 2d ed., 3, 1870, pp. 376–377.

"The first whale that we saw at sea was asleep, and as we passed quite close the ship was turned a little, for fear that upon awaking it might do us some harm. I saw one among the others extraordinarily large, and such that the captain and those who went about there said assuredly they had never seen a larger one. That which enabled one the better to appreciate his bulk and size was that in throwing himself about and bearing up against the sea, he made visible a part of his huge body. I was very much astonished by a *Gibar* which with its fin or its tail (for I could not well discern or recognize which it was) struck so terribly hard on the water, that one could hear it for a long distance, and I was told that it was to surprise and mass together the fish, in order afterwards to swallow them."[1]

He remarks also:

"All this bay [of Gaspé] was so full of whales that at last they inconvenienced us very much, and disturbed our repose by their continual bustle, and the noise of their spoutings."[2]

We have already seen that Baffin in his letter to Wolstenholme relative to his voyage of 1616 mentions the "Grand Bay" whale (or whale of the Strait of Belle Isle) which Eschricht believed to be *Balæna mysticetus*. (See p. 10.)

Champlain's account of Canada, already cited, which was published in 1632, contains this note:

"Codfish and whales are fished for along all the coasts of New France, in almost all seasons."[3]

NEW ENGLAND COAST.

None of the explorers of the 16th century make any reference, so far as I am aware, to the occurrence of whalebone whales in New England waters. In Brereton's account of Gosnold's voyage to Massachusetts in 1602, however, we find whales included in the list of "commodities" seen in the country, and the following remark:

"On the north side of this island [Martha's Vineyard? March, 1602] we found many huge bones and ribs of whales."[4]

Waymouth, who made a voyage to the coast of New England in 1605, remarks of the Indians:

"One especial thing is their manner of killing the whale, which they call powdawe; and will describe his form; how he bloweth up the water; and that he is twelve fathoms long; and that they go in company of their king with a multi-

[1] SAGARD-THEODAT, G., Le Grand Voyage au Pays des Hurons, 1632, pp. 24–27.

[2] *Op. cit.*, p. 40.

[3] LAVERDIÈRE, Œuvres de Champlain, 2d ed., 5, 1870, p. 663.

[4] BRERETON, JOHN, A Brief and True Relation of the Discovery of the North Part of Virginia, Made this Present Year 1602. London, 1602. *Mass. Hist. Coll.* (3), 8, p. 87.

tude of their boats, and strike him with a bone made in fashion of a harping iron fastened to a rope, which they make great and strong of the bark of trees, which they veer out after him: then all their boats come about him, and as he riseth above water, with their arrows they shoot him to death: when they have killed him and dragged him to shore, they call all their chief lords together, and sing a song of joy: and those chief lords, whom they call sagamores, divide the spoil, and give to every man a share, which pieces so distributed, they hang up about their houses for provision: and when they boil them, they blow off the fat, and put to their pease, maize, and other pulse which they eat."[1]

His landfall seems to have been at Nantucket [Cuerno?] and he remarks:

"Here [May 14, 1605] we found great store of excellent codfish, and saw many whales, as we had done two or three days before." [Somewhere near the Island of Cuerno in lat. 41° 20′.][2]

He also includes whales among the profitable things to be found in New England.[3]

These notes furnish no information as to the kind of whales obtained, but in John Smith's account of his voyage to New England in 1614 we find a definite allusion to the Finbacks. He writes:

[1614. JOHN SMITH'S VOYAGE TO NEW ENGLAND.]

"In the month of April, 1614, at the charge of Captain Marmaduke Roydon, Captain George Langam, Mr. John Buley and Mr. William Skelton, with two ships from London, I chanced to arrive at Monahigan [Monhegan] an isle of America, in 434 [43° 40′] of northerly latitude: our plot was there to take whales, for which we had one Samuel Cramton and divers others expert in that faculty, and also to make trials of a mine of gold and copper; if those failed, fish and furs were then our refuge to make ourselves savers howsoever: we found this whale-fishing a costly conclusion, we saw many and spent much time in chasing them, but could not kill any, they being a kind of imbartes, and not the whale that yields fins and oil, as we expected; for our gold it was rather the master's device to get a voyage that projected it, than any knowledge he had at all of any such matter; fish and furs were now our guard, and by our late arrival and long lingering about the whale, the prime of both those seasons were past ere we perceived it, we thinking that their seasons served at all times, but we found it otherwise, for by the midst of June the fishing failed, yet in July and August some were taken, but not sufficient to defray so great a charge as our stay required: of dry fish we made about forty thousand, of cor-fish about seven thousand."[4]

[1] Waymouth's Voyage in the Discovery of the Land of Virginia, written by James Rosier. London, 1605. *Mass. Hist. Coll.* (3), 8, p. 156.

[2] *Op. cit.* p. 131.

[3] *Op. cit.*, p. 157.

[4] SMITH, J., General History of New England. Pinkerton's Voyages, 13, 1812, p. 207.

Starbuck puts the matter in a somewhat different light, remarking that Smith "found whales so plentiful along the coast that he turned from the primary object of his voyage to pursue them." There appears to be nothing in the original narrative just quoted to justify this view.—STARBUCK, History of the American Whale Fishery. *Rept. U. S. Fish Com.*, pt. 4, 1878, p. 5, foot-note.

In Bradford's and Winslow's Journal of events in Plymouth Colony from 1602 to 1625 we find the following under date of November 11, 1620:

[1620. CAPE COD. BRADFORD'S AND WINSLOW'S "JOURNAL."]

[Nov. 11, 1620.] "And every day we saw whales playing hard by us; of which in that place, if we had instruments and means to take them, we might have made a very rich return; which, to our great grief, we wanted. Our master and his mate, and others experienced in fishing, professed we might have made three or four thousand pounds' worth of oil. They preferred it before Greenland whale-fishing, and purpose the next winter to fish for whale here."[1]

In the same Journal, among the arguments brought forward for the establishment of a settlement at Pamet River, on Cape Cod, is the following:

[1620. CAPE COD, MASS. BRADFORD'S AND WINSLOW'S "JOURNAL."]

"Thirdly, Cape Cod was like to be a place of good fishing; for we saw daily great whales, of the best kind for oil and bone, come close aboard our ship, and, in fair weather, swim and play about us. There was once one, when the sun shone warm, came and lay above water, as if she had been dead, for a good while together, within half a musket shot of the ship; at which two were prepared to shoot, to see whether she would stir or no. He that gave fire first, his musket flew in pieces, both stock and barrel; yet, thanks be to God, neither he nor any man else was hurt with it, though many were there about. But when the whale saw her time, she gave a snuff, and away."[2]

An account of a voyage to New England in 1629 contains the following reference to whales:

"This day [June 24] we had all a cleare and comfortable sight of America, and of the Cape Sable that was over against us 7 or 8 leagues northward. Here we saw yellow gilliflowers on the sea.

"Thursday [25th June] wind still N. E. a full and fresh gale. In the afternoon we had a cleare sight of many islands and hills by the sea shoare. Now we saw abundance of mackrill, a great store of great whales puffing up water as they goe,

[1] YOUNG, ALEX., Chronicles of the Pilgrim Fathers of the Colony of Plymouth from 1602 to 1625, Boston, 1841, p. 119. Bradford's and Winslow's Journal. Young comments on this paragraph as follows:

"Whales are frequently seen in Barnstable Bay and on the outside of the Cape, and are killed by boats from Provincetown. Occasionally, though more rarely of late, they come into the harbour; at the beginning of the present century, two or three whales, producing about a hundred barrels of oil, were annually caught; the last that was killed in the harbour was in Dec., 1840, a humpback, that made fifty barrels of oil. The appearance of a whale in the harbour is the signal for a general stir among the hundred graceful five-hand boats that line the circling shore of this beautiful bay. The American whale fishery commenced at Cape Cod, where it was carried on entirely in boats, which put off whenever a signal was given by persons on the look out from an elevated station, that a whale was seen to blow. In 1690 'one Ichabod Paddock' went from the Cape to Nantucket to teach the inhabitants of that isle the art and mystery of catching whales.—See *Mass. Hist. Coll.* (1), III, 157."

[2] *Op. cit.*, p. 146.

some of them came neere our shipp; this creature did astonish us that saw them not before; their back appeared like a little island."—(P. 42.)[1]

On another page[2] are again mentioned "huge whales going by companies and puffing up water-streames."

Richard Mather, in his voyage to New England in 1635, mentions seeing near that coast "mighty whales spewing up water in the air like the smoke of a chimney."[3]

In 1639, according to Starbuck, the Massachusetts colonies began to pass acts relating to the fisheries. The earliest paper relating to whales which he quotes is a proposition of the general court of Plymouth Colony respecting "drift fish," dated October 1, 1661.[4] Neither this nor the later documents give any clue to the kind of whales pursued, beyond passing references to whalebone and statements of the amount of oil obtained, but it is probable, judging from evidence of later date, that it was the Atlantic Right whale, *Balæna glacialis*.

NEW YORK BAY.

The only early historian of New York whose writings, so far as I have been able to ascertain, contain references to whales, is Adriaen Van der Donck. He came to New York about 1645, and about 1653 published the first edition of his Description of the New Netherlands. In this history he turns aside to mention the appearance of two whales in the Hudson River in 1647, and of four others which occurred there the same year, as follows:

[1656. VAN DER DONCK'S "DESCRIPTION OF THE NEW NETHERLANDS."]

"I cannot refrain, although somewhat out of place, to relate a very singular occurrence, which happened in the month of March, 1647, at the time of a great freshet caused by the fresh water flowing down from above, by which the water of the [Hudson] river became nearly fresh to the bay, when at ordinary seasons the salt water flows up from twenty to twenty-four miles from the sea. At this season, two whales, of common size, swam up the river forty miles, from which place one of them returned and stranded about twelve miles from the sea, near which place four others also stranded the same year. The other run farther up the river and grounded near the great Chahoos falls, about forty-three miles from the sea. This fish was tolerably fat, for although the citizens of Rensselaerwyck broiled out a great quantity of train oil, still the whole river (the current being still rapid) was oily for three weeks and covered with grease. As the fish lay rotting, the air was infected with its stench to such a degree that the smell was offensive and perceptible for two miles to leeward. For what purpose those whales ascended the river so far, it being at the time full forty miles from all salt or brackish water, it is difficult to say, unless their great desire for fish, which were plenty at this season, led them onward."[5]

[1] A True Relation of the Last Voyage to New England, begun the 25th of April, 1629, written from New England, July 24, 1629. Hutchinson's Coll. Orig. Papers on Hist. Mass. Bay, 1769.

[2] *Op. cit.*, p. 46.

[3] See his Journal. Quoted by Starbuck, *op. cit.*, p. 5, foot-note.

[4] STARBUCK, *op. cit.*, p. 7.

[5] VAN DER DONCK, A., A Description of the New Netherlands, 2d ed., 1656. *2 N. Y. Hist. Coll.*, 1, pp. 142–143. The first edition, according to the editor, was published about 1653.

These whales were quite probably Finbacks, although there is nothing in the narrative whereby to identify them beyond the statement that they were "of common size," and that the one which stranded near "the great Chahoos falls" was "tolerably fat." Van der Donck intimates that there was no fishery here at this time. He writes:

"There are [in the waters of the New Netherlands] also porpoises, herring-hogs, pot-heads or sharks, turtles, &c., and whales, of which there are none caught, but if preparations were made for the purpose, then it might be easily effected; but our colonists have not advanced far enough to pursue whaling. A lost bird, however, is frequently cast and stranded, which is cut up."[1]

This is more likely to refer to New York Bay (or North Bay, as it was called) than to the Delaware, or South Bay, for, as we shall see presently, there had been a fishery in the latter region some fourteen or fifteen years previously, which Van der Donck mentions elsewhere. Furthermore, the context applies to New York rather than to Delaware, and Van der Donck's residence was on the Hudson River. By the expression "a lost bird," he seems to mean a stranded whale.

LONG ISLAND.

In 1644, according to Starbuck, the town of Southampton, Long Island, appointed persons to attend to "drift" whales, and in 1651 the town of Easthampton arranged for persons to "loke out for whale." These towns and Southwold drew up a petition in 1672, in which it was stated that they had endeavored to establish a whale fishery for "about twenty years," but could not bring it to perfection until "within 2 or 3 years."

DELAWARE BAY.

Nothing regarding the occurrence of whales in Delaware Bay appears to have been put into print until De Vries published his account of the attempt of a Dutch company to establish a fishery there in 1631. This undertaking does not seem to have been successful. The kind of whale sought for is not described, but from the fact that De Vries remarks that they "come in winter and remain till March," it was presumably the Right whale. De Vries was employed as a patroon to plant a colony in the New Netherlands. The following references to this enterprise are of much interest:

[1631. DE VRIES'S NARRATIVE.]

"We at the same time equipped a ship with a yacht for the purpose of prosecuting the voyage, as well to carry on the whale fishery in that region, as to plant a colony for the cultivation of all sorts of grain, for which the country is very well adapted, and of tobacco. This ship with the yacht sailed from the Texel the 12th of December [1630], with a number of people and a large stock of cattle, to settle our colony upon the South River [Delaware River], which lies in the thirty-eighth and a half degree, and to conduct the whale fishery there, as Godyn represented

[1] VAN DER DONCK, A., A Description of the New Netherlands, 2d ed., 1656. *2 N. Y. Hist. Coll.*, i., p. 176.

that there were many whales which kept before the bay [Delaware Bay], and the oil, at sixty guilders a hogshead, he thought would realize a good profit, and consequently that fine country be cultivated.

"The 20th of same month, we understood that our yacht was taken the day but one before as it was running out the Texel, by the Dunkirkers, through the carelessness of the large ship. . . . (Pp. 15–16.)

"Anno 1631. . . . The ship conveyed the rest [of a lot of emigrants] to the South River [Delaware River] in New Netherland, and brought a sample of oil from a dead whale found on the shore. . . . (P. 16.)

"Anno 1632. The 12th of February we again entered into an agreement to equip a ship and yacht for the whale fishery, in which much profit had not been realized; because we had had such a losing voyage, and no returns from the whale fishery, and saw no prospect of any. But Samuel Godyn encouraged us to make another attempt. He said the Greenland Company had two bad voyages with Willen Van Muyen, and afterwards became a thrifty company. It was therefore again resolved to undertake a voyage for the whale fishery, and that I myself should go as patroon, and as commander of the ship and yacht, and should endeavor to be there in December, in order to conduct the whale fishing during the winter, as the whales come in the winter and remain till March. (P. 16.)

"The 12th of September [St. Martin's Id., West Indies], I let the ship have room, but the capture of a whale brought me to anchor. In New Netherland and in Patria [in Holland], this would have been a valuable prize. (P. 20.)

"The 5th [of Dec.], the wind southwest, we weighed anchor, and sailed into the South bay [Delaware Bay], and lay, with our yacht, in four fathoms water, and saw immediately a whale near the ship. Thought this would be royal work—the whales so numerous—and the land so fine for cultivation. (P. 22.)

"Anno 1633. The 1st of January . . . saw a whale at the mouth of the South river [Delaware River]:

"The 2d [Jan.], in the morning, fine and pleasant, saw two large whales near the yacht. (P. 24.)

"The 11th [Jan.]. Arrived about a half-a-mile above Minqua's kill, where we anchored, and saw a whale there that evening six or seven times. We were surprised to see a whale seven or eight miles up into fresh water. (P. 27.)

"The 13th [Jan.]. Came to the ship at Swanendael, where our friends were rejoiced to see us. We found that they had shot two whales, but they furnished little oil. (P. 27.)

"The 29th [March], we arrived again in the South Bay [Delaware Bay], at Swanendael, at our ships, where we were very welcome. Found that our people had caught seven whales, but there were only thirty-two cartels of oil obtained, so that the whale-fishery is very expensive, when such meagre fish are caught. We could have done more if we had had good harpooners, for they struck seventeen fish, and only secured seven, which is astonishing. They had always struck the whales in the tail. I afterwards understood from some Basques, who were old whale-fishers, that they always struck the harpoon in the fore-part of the back. . . . Having put our oil in the ship, taken down our kettle, and hauled in wood and water, we got ready to sail. (P. 38.)

"The 16th [April]. Arrived at noon before Fort Amsterdam [New York], and found a Company's ship there. She had brought a new governor, Wouter Van Twiller of Newkirk. . . . I went ashore to the fort, out of which he came to welcome me, and inquired of me also, how the whale-fishery succeeded. I answered him that I had a sample; but that they were foolish who undertook the

whale-fishery here at such great expense, when they could have readily ascertained with one, two, or three sloops in New Netherland, whether it was good fishing or not." (P. 39.)[1]

This fishery appears to have become somewhat more prosperous later, or at least to have been supplanted by another which was so, if we may credit Van der Donck, who writes in 1656, of events occurring between 1644 and 1653 as follows:

[1656. A. VAN DER DONCK'S "DESCRIPTION OF THE NEW NETHERLANDS."]

"Here [Delaware Bay] also is a good whale fishery. Whales are numerous in the winter on the coast, and in the bay, where they frequently ground on the shoals and bars; but they are not as fat as the Greenland whales. If, however, the fishery was well managed, it would be profitable."[2]

And again:

"Train oil can be made at the South bays [Delaware Bay], where whales are plenty."[3]

These statements may, I presume, be interpreted to mean either that a fishery was in operation, or that it could be established. The expression, "here is a good whale fishery," may perhaps mean only that here is a good fishing ground. As the whales are said to come in winter, they were presumably Right whales.

According to the late Prof. E. D. Cope, a letter of Wm. Penn, dated 1683, states that eleven whales were taken about the capes at the entrance to Delaware Bay that year.[4] I have not found the original of this statement, but in Penn's General Description of Pennsylvania, published in 1683, among the resources of the country is included "the whale for oil, of which we have good store; and two companies of whalers, whose boats are built, will soon begin their work, which hath the appearance of a considerable improvement."[5]

VIRGINIA TO FLORIDA.

I find no early references to the occurrence of whales on the Atlantic coast from the Chesapeake Bay to Florida. Mr. H. H. Brimley stated in 1894 that the Right whale fishery practised around Beaufort Inlet, North Carolina, had "been in existence many years,"[6] but does not give any details regarding its history. Lawson, in 1709, stated that no whales were killed on the coast of North Carolina at that time. (See the remark of Duhamel, quoted on p. 44.)

[1] DE VRIES, D. P., Voyages from Holland to America, A.D. 1632 to 1644. Trans. by H. C. Murphy. *2 N. Y. Hist. Coll.*, 3, pt. 1.

[2] *2 N. Y. Hist. Coll.*, 1, p. 139.

[3] *Op. cit.*, p. 235, in the Dialogue between a Patriot and a New Netherlander.

[4] *Proc. Acad. Nat. Sci. Phila.*, 1865, p. 168.

[5] Penn's Select Works, 4th ed., 3, 1825, p. 226.

[6] *Bull. of the N. C. Dept. of Agric.*, 14, No. 7, 1894, p. 5.

Laudonnière, who was on the coast of Florida in 1564, in mentioning one of the rivers remarks:

[June 22, 1564]. "Before departing I named this river the River of the Dolphins, because on my arrival I saw there a large number of dolphins playing about in the mouth of it."[1]

A remarkable story of the whale fishery of the Indians of Florida was told by Joseph de Acosta in his History of the Indies, the first edition of which appeared in 1590. This story was repeated again and again by later writers, and in spite of its marvellous character it was long before it disappeared from the histories.

In the quaint translation of Grimston it is as follows:

"But the combate which the Indians have with Whales is yet more admirable, wherein appeares the power and greatnesse of the Creator to give so base a Nation, as be the Indians, the industry and courage to incounter the most fierce and deformed beast in the worlde, and not only to fight with him, but also to vanquish him, and to triumph over him. Considering this, I have often remembred that place of the Psalme, speaking of the Whale, *Draco iste, quem formasti ad illudendum eum.* What greater mockerie can there be then to see an Indian leade a whale as bigge as a mountaine vanquished with a corde. The maner the Indians of Florida vse (as some expert men have tolde me) to take these whales (whereof there is great store) is, they put themselves into a canoe, which is like a barke of a tree, and in swimming approach neere the whales side; then with great dexteritie they leape to his necke, and there they ride as on horsebacke, expecting his time, then hee thrustes a sharpe and strong stake, which hee carries with him, into the whales nosthrill, for so they call the hole or vent by which they breathe; presently he beates it in with an other stake as forcibly as hee can; in the meane space the whale dooth furiously beate the sea, and raiseth mountaines of water, running into the deepe with great violence, and presently riseth againe, not knowing what to doe for paine; the Indian still sittes firme, and to give him full payment for this trouble, he beates another stake into the other vent or nosthrill so as he stoppeth him quite, and takes away his breathing; then hee betakes him to his canoe, which he holdes tied with a corde to the whales side, and goes to land, having first tied his corde to the whale, the which hee lettes runne with the whale, who leapes from place to place whilest he finds water enough; being troubled with paine, in the end hee comes neere the land, and remains on ground by the hugenesse of his body, vnable any more to moove; then a great number of Indians come vnto the conquered beast to gather his spoiles, they kill him, and cut his flesh in peeces, this do they drie and beate into powder, vsing it for meate, it dooth last them long: wherein is fulfilled that which is spoken in another Psalme of the whale, *Dedisti eum escam populis Æthiopum.*"[2]

BERMUDA.

In 1665 we have for the first time a short account of a whale fishery at the Bermudas (published anonymously in the first volume of the *Philosophical*

[1] LAUDONNIÈRE, R., Hist. de Florida. *Bibl. Elzevir*, 1853, p. 68.

[2] ACOSTA, J., The Natural and Moral History of the Indies. Reprinted from the English translated edition of Edward Grimston, 1604, pp. 148–150 (revised by Clements R. Markham). Hakluyt Soc., London, 1880.

Transactions) which is explicit as to the size and shape of the whales, the months in which they are found, and other matters.[1] The whales were Humpbacks. Two old females and three cubs were taken at first and afterwards 16 other individuals. One old female was 88 ft. long, the flukes 23 ft. broad, the flipper 26 ft. long, the baleen 3 ft. long. The other female was about 60 ft. long, and of the cubs one was 33 ft. long, and the remaining two 25 or 26 ft. The writer states that the whales occurred only from the beginning of March to the end of May (or of April), after which they left the coast and were supposed to go to the Gulf of Mexico.

In the second part of this article reference is made to the stranding of a sperm whale on the New England coast,—"of that sort which they call *Trumpo*," and further that "these whales were to be met with, between the Coast of *New-England* and *New-Netherland*, where they might be caught eight or nine months in the year."

This subject was taken up again in 1667 by Richard Norwood, an "intelligent gentleman living upon the place," but he seems to have had his information entirely at second-hand.

"For the *killing of Whales*, it hath been formerly attempted in vain, but within these 2 or 3 years, in the Spring-time and fair weather, they take sometimes one, or two, or three in a day. They are less, I hear, than those in *Greenland*, but more quick and lively.

". . . I have heard from credible persons that there is a kind of such as have the *Sperma* at *Eleutheria*, and others of the *Bahama* Islands (where also they find often quantities of *Amber-greese*) and that those have great teeth (which ours have not) and are very sinewy."[2]

The next year, 1668, Norwood's friend, Richard Stafford, Sheriff of the Bermudas, who appears to have been a practical whaler, wrote a letter to the Royal Society in which the whale fishery is again referred to. His statements, though erroneous in some particulars, are very interesting, and are, so far as I know, the first recorded observations of any person who was familiar with whales in American waters from having actually himself taken part in their capture. He writes:

"We have hereabout [the Bermudas] very many sorts of Fishes. There is amongst them great store of Whales, which in March, April and May use our

[1] Anon., Of the New American Whale-fishing about the Bermudas. *Philos. Trans.*, 1, No. 1, March 6, 1665, pp. 11–13.

Anon., A Further Relation of the Whale-fishing about the Bermudas, and on the Coast of New-England and New-Netherland. *Philos. Trans.*, 1, No. 8, Jan. 8, $166\frac{5}{6}$, pp. 132, 133.

This fishery was to be begun March 22, 1664, but it appears not to have been until April. (See Lefroy, Memorials of the Bermudas, 2, pp. 211 and 214.)

[2] Norwood, Richard. An Extract of a Letter, written from the Bermudas, giving an account of . . . the Whale-fishing there practised anew, and of such Whales as have the Sperma Ceti in them. *Philos. Trans.*, 1, No. 30, 1667, pp. 565–567. Norwood made the first surveys of the islands and divided them into shares.

Coast. I have myself killed many of them. Their Females have abundance of Milk, which their young ones suck out of the Teats, that grow by their Navell. They have no Teeth, but feed on Mosse, growing on the Rocks at the bottom during these three Moneths, and at no other season of the Year. When that is consumed and gone, the Whales go away also. These we kill for their Oyl. But here have been *Sperma-Ceti-Whales* driven upon the shore, which *Sperma* (as they call it) lies all over the Body of those Whales. These have divers Teeth, which may be about as big as a Man's wrist; and I hope by the next opportunity to send you one of them. I have been at the *Bahama*-Islands, and there have been found of this same sort of Whales dead on the shore, with *Sperma* all over their Bodies. Myself with about 20 more have agreed to try, whether we can master and kill them, for I could never hear of any of that sort, that were kill'd by any man; such is their fierceness and swiftness. One such Whale would be worth many hundred pounds. They are very strong, and inlay'd with sinews all over their Body, which may be drawn out thirty fathom long." [1]

There are various statements regarding this fishery in the colonial records of the Bermudas, a large body of which was published in convenient form by Sir J. H. Lefroy in 1879.[2] These include the papers of Norwood and Stafford already quoted, but are chiefly orders of the proprietors of the islands to the successive governors concerning the regulation of the fishery, reports of the governors to the proprietors, and various proclamations and court decisions relating to the conduct of the industry. In these papers references are occasionally made to the seasons in which the whales appear at the islands, and some other allusions to their habits, but very little is said regarding the whales themselves.

While many complaints were made by the proprietors in London that whale oil was not sent them as it should have been, whalebone is seldom referred to. It is usually mentioned as something which might be expected to form a valuable product of the industry, but never as a product actually in hand. From this it would appear that to the close of the 17th century at least, the Right whale was not taken at the islands, for it is not probable that the valuable whalebone of that species would have been ignored.

We hear nothing of the Bermuda Hump back fishery again for a very long time. Mr. J. Matthew Jones, of Nova Scotia, stated in 1884, that it was "prosecuted by the islanders with more or less success from the earliest times until the present." [3] He seems to be of the opinion, however, that the Right whale was the species sought for, but there is very good reason to believe that the statements of Norwood and Stafford, in 1667 and 1668, relate to the same whale as that mentioned in the anonymous accounts of 1665, and the latter was undoubtedly the Humpback. Later, the Right whale may have been captured, as it was on the coast of New England, and it is possible that at a comparatively early date attention

[1] STAFFORD, RICHARD, An Extract of a Letter, written to the Publisher from the Bermudas by Mr. Richard Stafford; concerning the Tydes there, as also whales, *Sperma Ceti*, (etc.). Bermuda, July 16, 1668. *Philos. Trans.*, 3, No. 40, 1668, pp. 792–794.

[2] LEFROY, J. H., Memorials of the Discovery and Early Settlement of the Bermudas or Somers Islands, 1511–1687. 2 vols., London, 1877–79.

[3] *Bull. U. S. Nat. Mus.*, No. 25, 1884, p. 148.

was transferred largely, if not wholly, from the Humpback to the Right whale, but of this there is no evidence.

In 1902 Professor A. E. Verrill published a brief statement regarding whales at Bermuda, citing the early records and adding a few data of recent date. The baleen whales which he includes as having been seen or captured about the islands are a Humpback, a Finback, and a Right whale.[1]

WEST INDIES.

Two comparatively early explorers of the West Indies, Rochefort (1658) and Du Tetre (1667), have some little to say regarding the cetaceans of those waters. Rochefort in his History of the Antilles, after mentioning the marine monsters found in those parts, and describing two species of *Marsouins* or porpoises, has an article on "whales and other monsters of the sea," from which the following:

"Those who travel about these islands sometimes see whales in their journeyings, which throw up water from their blowhole to the height of a pike, and which only show ordinarily a little of their back, which resembles a rock above water.

"Ships are also sometimes accompanied for quite a long time by monsters which are of the length and breadth of a boat *(chalouppe)*, and which seem to find pleasure in thus showing themselves. The sailors call them *Morhous* or *Souffleurs* (puffers), because that from time to time these prodigious fish put a part of their head out of water, to take breath, and then they blow and scatter the water from in front of their pointed snouts. Some say that it is a species of large porpoise."[2]

These whales would appear to be Finbacks, though it is possible, of course, that the reference is to some species of ziphioid whale, perhaps *Ziphius cavirostris*, or that various kinds of whales are confounded.

Du Tetre in his General History of the Antilles (1667–71) speaks first of the "great number of whales, of puffers *(Souffleurs)* and of porpoises" about Martinique and then devotes a section of his work to whales. In this section he throws some light on the *Souffleur*, but hardly enough to make it certain what it really is. The matter is as follows:

"Whales are seen about these islands [Antilles] from the month of March to the end of May more frequently than in all the rest of the year. They are in heat and copulate at this time, and one sees them roaming about principally in the morning, all along the coast, two, three or four, all in a school, blowing and as if syringing from their nostrils two little rivers of water, which they blow into the air to the height of two pikes, and in this effort they make a kind of bellowing (*meuglement*) which may be heard for a good quarter of a league. When two males meet near one of the females they join battle and give themselves over to a dangerous combat, striking the sea so hard with their fins and tail that it seems as if they were two ships engaged with cannon."[3]

[1] Verrill, A. E., The Bermuda Islands. *Trans. Conn. Acad.*, 11, 1902, pp. 682–688.

[2] Rochefort, C. de, Hist. Nat. et Morale des Isles Antilles, 1st ed., 1658, p. 179.

[3] Du Tetre, J. B., Hist. Gén. des Antilles, Tom. 2, Traité 4, "Des Poissons," 1667, p. 196.

Then follows a paragraph as to the size being exaggerated by René François, and then the story of the Florida Indians from Acosta, after which comes an account of an accident caused by a whale getting under a boat near Martinique. A little farther on the following important passages occur:

"One sees more whales around Martinique than at Guadaloupe, because the sea there is more channeled and deeper, from which it arises that they can frequent these shores with less danger than those of Guadaloupe, which are less steep, and where there are more keys and shallows, where they might more easily strand and perish.

"Of *Souffleurs.*—The *Souffleur* is a large fish, which one might with much reason consider a species of whale, supposing that one might employ the word whale in a generic sense; for it has so much resemblance to that animal that it differs from it only in size; it blows and syringes the water into the air through its nostrils, like the whale, although a much smaller quantity, so that many take them for small whale cubs, though it may be an entirely different kind of fish. They go in schools like the porpoises, and it is only necessary to whistle to make them turn suddenly and approach the ships, but it is not all play to capture them, for they are endowed with a force so extraordinary, that a captain of a ship assured me that one day having harpooned one, it made such a violent strain on the line attached to the harpoon that it broke the large yard of his mast where this line was fastened. They are in great numbers on all these coasts; it seems as if they had a liking for men, for they follow the canoes and boats, as though it gave them pleasure to hear the noise that is made."[1]

PACIFIC COAST.

The earliest reference to whales on the west coast of North America which I have found is in Oviedo's chapter "on the whales which are in the seas of the islands and mainland of the Indies," in Ramusio's Voyages. This relates to an incident which occurred in the year 1529, a very early date, earlier indeed than that of the incident mentioned by Cartier as occurring in the Gulf of St. Lawrence, to which reference has already been made (p. 14).

Oviedo's account is as follows:

"I will relate what I myself with many others saw in the mouth of the Gulf of Orotigna, which is 200 leagues distant from the town of Panama toward the West. . . . In 1529, going out of the Gulf into the open sea, to go to the town of Panama, we saw at the mouth of the Gulf a fish or marine animal extremely large, and which from time to time raised itself straight out of the water. And that which was to be seen above the water, which was only the head and two arms, was considerably higher than our caravel with all its masts. And being elevated in that way it let itself fall and struck the water violently, and then after a little time returned to repeat the act, but not, however, throwing up any water from the mouth, although in falling down with the blow and the fall it made much water rise up into the air. And a cub of this animal, or one like it but much smaller, did the same, deviating always somewhat from the larger one. And from what the sailors and others who were in the caravel said they judged it to be a whale, and the smaller a whale's cub. The arms which they showed were very large, and

[1] Du Tetre, J. B., Hist. Gén. des Antilles, 2, 1667, pp. 196–197.

some have said that the whale has no arms. But the one which I saw, was of the manner I have said, for I went with the others in the caravel, where came also Father Lorenzo Martino, canon of the church of *Castiglia dell' Oro;* and the pilot was John Cabezas; and with us came also a gentleman named Sancio di Tudela, with many others, who are alive and can testify the same thing, because I would never wish to speak of such things without witnesses. By estimate, and as it seemed to me, each arm of this animal might be 25 feet long and as thick as a barrel and the head more than 14 or 15 feet long, and very much thicker and the rest of the body more than as much again.

"It raised itself up and that which it showed in height was more than five times the height of a middle-sized man, which makes 25 feet. And the fear was not a little that all had when with its leaps it came alongside our vessel, because our caravel was small. And from what we could surmise it seemed that this animal felt pleasure, and made holiday of the weather which was approaching; for soon there arose in the sea a strong west wind, which was much to our advantage, for sailing along in a few days we reached the town of Panama."[1]

From the size and shape of this whale and especially from the length of its pectoral fins and its manner of putting its head out of water, there is strong probability that it was a Humpback whale.

In 1539 Francis Ulloa cruised along the Pacific coast of Central America, penetrated the Gulf of California, and passing out of it again proceeded to Cerros Island. In his passage around Cape St. Lucas he encountered a large school of whales, which he refers to as follows:

"Before we came to this point of the haven of Santa Cruz [in the Gulf of California] by six or seven leagues, we saw on the shore between certain valleys divers great smokes. And having passed the point of this port our Captain thought it good to launch forth into the maine ocean, yet although we ran a swift course, about 500 whales came athwart of us in 2 or 3 skulles [schools] within one houre's space, which were so huge, as it was wonderful, and some of them came so neere unto the ship, that they swam under the same from one side to another, whereupon we were in great feare, lest they should doe us some hurt, but they could not because the ship had a prosperous and good winde, and made much way, whereby it could receive no harme, although they touched and strooke the same."[2]

In the account of Viscaino's voyages along the outer coast of Lower California in 1603, given by Torquemada,[3] it is mentioned that the *Baia de Ballenas*, or Bay of Whales, was so named by the explorer on account of the numbers of whales seen there. This was in July, 1602.

There are, according to H. H. Bancroft, but four voyages to be comprised under the title of early voyages for the discovery of California. These are Ferrelo's voyage, 1543; Drake's voyage, 1579; Gali's voyage, 1584; and Viscaino and Aguilar's voyage, 1603. An examination of the accounts of the first three fails to reveal any mention of whales, but in Viscaino's voyage of 1603 these animals were en-

[1] Ramusio, Navigationi et Viaggi, 3, p. 156.

[2] *Op. cit.*, pp. 353–354. Translation from Hakluyt, 3, pp. 423–424.

[3] Torquemada, Monarchia Indiana, 1, 1723, p. 702.

countered. The ships which were to make this voyage assembled in the harbor of Monterey, from which they started for Cape Mendocino, January 3, 1603. The resources of the Monterey region are described and among other things are mentioned "seals, very large, and many whales."[1]

Alaska was discovered by Vitus Bering in 1740, and in the account of the memorable and ill-starred expedition which Steller has given us we find several references to whales, the first, so far as I know, for that part of America. After the landfall at Mt. St. Elias in July, 1740, Bering steered northward and encountered the peninsula of Aliaska and the Aleutian Islands. It was while threading their way through this archipelago that the voyagers noticed the larger cetaceans.

Steller first remarks on them as follows:

"From the 20th to the 23d [of August, 1740] we tacked along the Parallel of 53°. I now saw whales very numerous, not singly any more, but in pairs, and travelling in pairs with and behind one another and following one another, which provoked in me the thought that this must be the time fixed for their rut."[2]

This observation appears to have been made when the vessel was between the Aleutian and the Shumagin Islands. A little later Steller remarks again:

"The wind was favorable for us so that toward 2 o'clock in the afternoon [Sept. 6, 1740] we lost sight of the mainland and islands. But the numerous whales which accompanied us, one of which thrust more than half its length upright out of the sea, made us understand that a storm was brewing."[3]

"The 13th of September [1740] was a bright day. . . . Moreover, many whales were seen playing and we expected nothing good."[4]

[1] TORQUEMADA, Monarchia Indiana, 1, 1723, p. 717.

[2] STELLER, G. W., Reise von Kamtschatka nach Amerika, 1793, p. 42.

[3] *Op. cit.*, p. 76.

[4] *Op. cit.*, p. 78.

CHAPTER II.

A CHRONOLOGICAL ACCOUNT OF IMPORTANT CONTRIBUTIONS TO THE NATURAL HISTORY OF NORTH AMERICAN WHALEBONE WHALES.

Knowledge of whales, as of other animals, owes its principal advancement to the observations of three classes of persons,—the explorer and traveller, who notices them casually among the varied wonders of nature; the naturalist, amateur, or professional; and the person engaged in, or interested in, industrial pursuits.

To the casual observations of the earliest discoverers and explorers of America we have already given attention, and in the whale fishery we have no direct interest at present. We shall present, therefore, in this chapter a brief account of American and European writings, whether by naturalists or practical whalemen, which have contributed to a considerable extent to the advancement of knowledge of the whalebone whales found in North American waters. Writings on the Greenland whale, *Balæna mysticetus*, will be excepted, because the present work does not cover that species. This exception is an important one, involving a number of early treatises of much value, such as those of Zorgdrager, Scoresby, etc., which contain excellent accounts of the whale fisheries about Greenland and of the habits of the Greenland whale.

So far as writings of American zoölogists are concerned, the number relating to baleen whales is surprisingly small, a fact due no doubt to the great difficulty of assembling and maintaining cetological collections, and the scarcity of opportunities for examining living or fresh specimens under favorable conditions. The cetological collections of Europe are for the most part the accumulations of centuries. In America, even to-day, such collections are exceedingly meagre, and it is scarcely to be wondered at, therefore, that so few American naturalists have had anything to say about this order of mammals.

While, as above noted, the present work does not deal with the whale fishery, it should be repeated that some of the most substantial contributions to the natural history of whales have been derived directly or indirectly from persons engaged in, or interested in, that industry, and, indeed, without these treatises cetology would be exceedingly deficient in certain directions.

1. *Natural Histories and Miscellaneous Contributions.*

Seventeenth Century.

The writings of naturalists covering the period between the middle of the sixteenth and the middle of the eighteenth centuries, beginning with the treatises of Rondelet (1554) and Olaus Magnus (1555) and ending with the tenth edition of

Linnæus's Systema Naturæ, may be conveniently divided into three classes. In the first class belong the general natural histories, commonly covering the whole field of geography, zoölogy, botany, anthropology, and often other branches of science as well. These works are descriptive rather than systematic, and frequently contain reflections on and discussions of philological, theological, and political subjects.

The second class comprises works relating more strictly to animals, plants, and minerals, but in which little or no attempt is made to classify the various natural objects described. Finally, we have the formal natural histories, the precursors of the systematic works of the present time. As zoölogies of this third class do not make their appearance before the beginning of the eighteenth century, we shall look in vain for any systematic treatment of the subject under consideration in advance of that time.

In the two centuries, 1553–1758, the whale fishery received the largest share of attention. Discussions of the identity of the unicorn, involving descriptions of the Narwhal, occupy the next place, while little less extensive were the inquiries regarding the origin of ambergris and the nature of the whale which swallowed Jonah. The industrial treatises cover nearly the whole period, but those on the unicorn seem to have had their origin about the middle of the seventeenth century, and those on ambergris and on Jonah's whale in the later decades of that century.

None of the early naturalists, such as Rondelet (1554), Gesner (1551), or Belon (1551), made any reference to the observations of the American explorers or to American cetaceans in any wise. American cetology opens in 1590 with Acosta's fable of the Florida Indians, who, as he learned from "some expert men," captured whales by driving plugs into their blowholes.[1] This fable was repeated by De Bry in 1602, who published a plate showing the Indians engaged in this marvellous whale fishery.[2] Lescarbot quotes from Acosta in 1609[3] and Nieremberg also tells the story in 1635, but seems inclined to discredit it.[4] Du Tetre also repeats it in 1667.

Rochefort's Natural History of the Antilles, published in 1658, contains the next reference to baleen whales in North American waters. A translation of his remarks has already been given on p. 30. Though his description is far from satisfactory, it seems to have reference to some species of Finback whale. This is the more probable as Du Tetre in his History of the Antilles, published in 1667, has a fuller description under the same heading, as we have already seen in the preceding chapter, pp. 30, 31.

Eighteenth Century.

In 1703, La Hontan, in his New Voyages to North America, enumerates (1) "*Balenots*, or little whales"; (2) "a fish almost as big as a whale, called

[1] Acosta, J., Hist. nat. y moral de las Indias, Seville, 1590, pp. 158–162.

[2] De Bry, T., Idæa vera et genuina, Præcipuarum Historiarum omnium, ut et variorum Rituum, Ceremoniarum (etc.) gentis Indicæ, Frankfort, 1602, pl. 1.

[3] Nova Francia. English ed., 1609, p. 269.

[4] Nieremberg, J. E., Historia naturæ, Antwerp, 1635, p. 261.

Souffleur"; and (3) "white porpoises," among the fishes of the St. Lawrence River. His descriptions of these, which are extremely unsatisfactory, are as follows:

"The *Balenot* is a sort of a whale, only 't is less and more fleshy, and does not yield Oil in proportion to the Northern Whales. This Fish goes fifty or sixty Leagues up the River.

"The *Souffleurs* are much of the same size, only they are shorter and blacker, When they mean to take breath after diving, they squirt out the water through a hole behind their Head, after the same manner with the Whales. Commonly. they dog the Ships in the River of *St. Laurence.*

"The *White Porpoises* are as big as Oxen. They always go along with the Current; and go up with the tide till they come at fresh water, upon which they retire with the ebb water. They are a ghastly sort of Animals, and are frequently taken before *Quebec.*" [1]

The "white porpoise" is, of course, the Beluga, or White whale, *Delphinapterus*, but the others are not certainly recognizable.

Charlevoix published a few notes on the whales found in the St. Lawrence in his History and General Description of New France, the most important of which is the following: "I have remarked in my *Journal* that having been at anchor in 1705 at the end of the month of August near Tadoussac, about 15 leagues above Matave, I have seen 4 of them [*i. e.*, whales] at the same time playing around our vessel, and approaching in such manner that one might have touched them with the oars; but it is principally on the coasts of Acadie that the fishing offers an inexhaustible fund for commerce." [2]

In 1709 Lawson, in his natural history of the Carolinas, makes mention for the first time of whales in those waters, but his account is vague and far from satisfactory. His list includes "whales, several sorts"; "crampois [grampus]"; "bottle-noses," and porpoises. He remarks: "Whales are very numerous on the coast of North Carolina, from which they make Oil, Bone, etc. to the great Advantage of those inhabiting the Sand Banks, along the Ocean, where these whales come ashore, none being struck or kill'd with a Harpoon in this Place, as they are to the Northward, or elsewhere." [3]

Lawson's descriptions of the various kinds of whales are uncritical and confused. He says:

"Of these Monsters, there are four sorts; the first, which is most choice and rich, is the *Sperma Cæti* whale, from which the *Sperma Cæti* is taken. These are rich Prizes; but I never heard but of one found on this Coast, which was near *Currituck*-Inlet [North Carolina].

"The other sorts are of a prodigious Bigness. Of these the Bone and Oil is made; the Oil being the Blubber, or oily Flesh, or Fat of that Fish boil'd. These differ not only in Colour, some being pied, others not, but very much in

[1] La Hontan, New Voyages to North America, London, 1703, p. 244.

[2] Charlevoix, P. F. X. de, Histoire et Description générale de la Nouvelle France, 2, 1744, p. 389.

[3] Lawson, John, The History of Carolina, London, 1714, p. 153. This is the 2d ed. The first published in 1709, I have not seen. Allen states that the two editions are textually identical.

shape, one being call'd a Bottle-Nosed Whale, the other a Shovel-Nose [shark?], which is as different as a Salmon from a Sturgeon. . . .

"There is another sort of these Whales, or great Fish, though not common. I never knew of above one of that sort, found on the Coast of North *Carolina*, and he was contrary, in Shape, to all others ever found before him, being sixty Foot in Length, and not above three or four Foot Diameter [Finback?]."[1]

Lawson includes, without comment, Acosta's story, published more than a century before, of the Florida Indians killing whales by driving plugs into their blowholes.

In Catesby's Natural History of Carolina, the first edition of which was published in 1731–33, we read only that "whales of different species are sometimes cast on shore, as are Grampus's, in storms and hurricanes."[2]

Brickell, in 1737, in his Natural History of North Carolina, repeats parts of Lawson (1709) word for word, with some unimportant additions of his own.[3]

In 1725 we meet with the first original account of the whales of New England by an American colonist. This contribution, entitled "An Essay upon the Natural History of Whales,"[4] was written by Paul Dudley, Chief-Justice of Massachusetts, who was at once a jurist, a theologian, and a naturalist. He probably had little acquaintance with the subject from his own observation, and took his information at second or even at third hand. He tells us that he was informed as regards ambergris by a Mr. Atkins of Boston, a practical whaler, "one of the first that went out a fishing for the Sperma Ceti whales," and that on the other topics he had the assistance of Mr. J. Coffin of Nantucket and Rev. Mr. Greenleafe of Yarmouth.

Dudley's essay, on account of the amount of original and generally accurate information it contains, deserves to take rank with those of Martens, Sibbald, Scoresby, and Zorgdrager. It is not a systematic treatise, but the several kinds of whales occurring on the New England coast are named and briefly described, with notes on their habits, reproduction, and other matters. The whales mentioned are: (1) "The Right, or Whalebone Whale"; (2) "The Scrag Whale"; (3) "The Finback Whale;" (4) "The Bunch, or Humpback Whale"; (5) "The Sperma Ceti Whale."

All of these are recognizable and have been assigned to their proper places generically, except the "Scrag" whale, which is, and always has been, a stumbling-block to cetology. It was accepted, without criticism, as a separate species by Klein, Anderson, and other writers. In 1869, Nathaniel E. Atwood, a practical fisherman, and a well educated and observant man, who resided for many years at Provincetown, Mass., stated that the whalers there recognized a "Scrag" whale, but regarded it as the young of the Right whale.[5] Scammon remarks: "Our

[1] *Op. cit.*, pp. 153–154. Lawson was Surveyor-General of North Carolina.

[2] This is from the edition of 1743, vol. 2, p. xxxii, which, however, appears not to differ from the original edition.

[3] Brickell, J., The Natural History of North Carolina, 1737, pp. 215–226.

[4] *Philos. Trans.*, 33, No. 387, Mch. and Apr., 1725, pp. 256–269.

[5] Allen, J. A., Catalogue of the Mammals of Massachusetts. *Bull. Mus. Comp. Zoöl.*, 1, No. 8, 1869, p. 203.

observations make it certain that there is a 'Scrag' Right whale in the North Pacific which corresponds very nearly to that of the southern ocean."[1] Macy, in his History of Nantucket, informs us that it was the appearance of "a whale of the kind called Scragg" in the harbor there which led to the establishment of the whale fishery on that island.[2]

From these three observations it is evident that the term "scrag" is regularly included in the whaleman's vocabulary. That there is a separate species to which the name applies is improbable, but it is still uncertain whether it merely characterizes abnormal individuals of the various species of Right whales, or definite varieties of one or more species of Right whales, or abnormal individuals of the large whales generally. The word "scrag," of course, means emaciated, ill-favored, or rough and crooked. Further reference to this subject will be made later on.

In 1741, we have for the first time, in Klein's Historia Piscium, a summing up by a systematist of the American observations prior to that date. His classification is somewhat artificial and his nomenclature rather unsystematic. His synoptic table, in so far as it applies to the large whales, is as follows[3]:

Physeteres { I Balænæ { I. Edentulæ { 1. In Dorso lævi apinnes. 2. In Dorso gibbo apinnes. 3. In Dorso pinnatæ.
II. Dentatæ { 1. Dorso lævi apinnes. 2. Dorso lævi pinnatæ. 3. Dorso gibbo apinnes. 4. Dorso gibbo pinnatæ.

The various species enumerated are as follows:

BALÆNÆ EDENTULÆ.

In Dorso lævi apinnes.

1. *Balæna vera Zorgdrageri.* [= Bowhead.]
2. *Balæna albicans;* Weisfish *Martensii & Zorgdr.* [= White whale.]
3. *Balæna glacialis;* ita communiter: Eisfisch.
   - *a.* Australis; Zud-Eisfisch; dorso valde depresso, *Zorgdrageri.*
   - *b.* Occidentalis; West-Eisfisch; dorso minus depresso, *Ejusdem.*
   - *c.* Borealis; Nordkaper, *Ejusdem.* [= Atlantic Right whale.]

In Dorso gibbo apinnes.

1. Gibbo unico prope caudam. *Anglis: The Bunch or Humbak Whale* . . . Finfisch. Vid. *Transact. Phil.* Vol. XXXIII. No. 387. P. 258. [= Humpback whale of Dudley.]
2. Gibbis vel Nodis sex. *Balæna macra. Anglis:* Scrag-Whale. . . . *Phil. Trans., ibid.* [= Scrag whale of Dudley].

In Dorso pinnatæ.

1. *Ore Balænæ vulgaris,* laminis corneis donato.
   - *a.* Balæna edentula, corpoire strictiore, dorso pinnato *Raji. Finfish Zorgdr.* Physeter *Gesn. Anglis.* Finbak-Whale. . . . *Phil. Trans. al. l.* [Includes the Finback of Dudley.]
   - *b. Jubartes;* Balæna novæ Angliæ. [The Bermuda Humpback of the anonymous writer in *Philos. Trans.*, 1, 1665, pp. 11–13.]
2. *Ore rostrato.* [Not American.]

[1] SCAMMON, C. M., Marine Mammals, 1874, p. 67.

[2] MACY, O., History of Nantucket, 1835, p. 28.

[3] KLEIN, J. T., Historiæ Piscium naturalis, pt. 2, 1741, pp. 9–16.

BALÆNÆ DENTATÆ.

Dorso lævi apinnes.

1. *Cete Clusii Exot.* [Not American.]
2. *Cachelot* s. Potfish *Zorgdrageri.* [= Sperm whale.]

Dorso lævi pinnatæ.

1. *Balæna major.* [Not American.]
2. *Mular Nierembergii.* [Do.]
3. *Linckii.* [Do.]

Dorso gibbo apinnes.

Dudleji Balæna. [= Sperma Ceti whale of Dudley.]

Dorso gibbo pinnatæ.

Balæna, Tigridis instar, variegata.

In 1741 appeared the first edition of Egede's Description of Greenland. Egede was for twenty-five years a missionary in that country and must have had many opportunities for obtaining information regarding whales. He mentions and briefly describes various cetaceans, including "the Whale" (Bowhead), the "Finned whale" or "Fin-Fish," the "Nord Caper," and the "Cachelot." The matter relating to the "Nord Caper" appears to have been extracted from some earlier author, but the remainder is original. It is for the most part accurate, and is of interest on account of the frequency with which it is quoted by later writers.[1]

In 1746 John Anderson, burgomeister of Hamburg, a scholarly writer and painstaking naturalist, published an excellent résumé of what was then known of whales in northern waters, in his Nachrichten von Island, Grönland und der Strasse Davis.[2] He appears not to have acquired any knowledge of the natural history of the cetaceans by direct observation, but diligently pursued inquiries among the whalers and fishermen who came to Hamburg. He took every opportunity to examine the treasures in the various European museums then established, and assembled a natural history cabinet of his own.

In the course of his essay on Greenland and Davis Strait, Anderson stops to consider the cetaceans. He includes and comments on the various species mentioned by Paul Dudley in 1725, and the earlier anonymous writer in the *Philosophical Transactions.* His classification and the species of whalebone whales mentioned are as follows:

Genus *Cetaceum.*

(1) Whales with blowholes.
(2) Whales with nostrils.[3]

Or,

(1) Whales with smooth backs. [=*Balæninæ.*]
  (*a*) The true whale, or Greenland Right whale. [=*Balæna mysticetus.*]
  (*b*) The Nordcaper. [=*B. glacialis* or *biscayensis.*]
(2) Whales with the back grown out. [=*Balænopterinæ.*]

[1] EGEDE, H., A Description of Greenland. Translated from the Danish. London, 1745, pp. 65–82, pls. 5 and 6. I have not seen the original edition. [2] Hamburg, 1746, pp. 95–103, 185–230.

[3] Anderson comments on the fact that the Greenland whalemen have not seen any of the second class, and states that he would disbelieve in their existence but for Sibbald's observations. Sibbald, however, while speaking of nostrils really describes the blowholes, having apparently become confused between the simple blowhole of the toothed whales and the double one of the whalebone whales.

(1) With a dorsal fin. [=*Balænoptera.*]
  (*a*) The Finfish. [=*Balænoptera physalus.*]
  (*b*) The Jupiter, or Jupiter-fish. [Includes (with a query) the Humpback of the Bermudas, and the *Balæna vera* of Rondelet, and *Balænoptera physalus.*]

(2) With one or more knobs [*Puckeln*].
  (*a*) "The Swordfish of our Greenland voyagers." [=*Orcinus.*]
  (*b*) The American "Pflockfisch." [=The Humpback of Dudley.]
  (*c*) The "Knotenfisch" or "Knobbelfisch." [=Scrag whale of Dudley.]

On page 197, Anderson discusses the identity of the Jupiter-fish and remarks that he cannot state positively what it is. He gives, however, an excellent description, derived from certain fishermen, of one killed in 1723, which is clearly *Balænoptera physalus.* He suspects that this is the same as the whale occurring in the Bermudas, described by the anonymous writer of 1665 in the *Philosophical Transactions*, and there said to resemble the "Jubartes"[1]; but in this he was mistaken as the whale there described was the Humpback. He gives Latin polynomial names to Dudley's Humpback and Scrag whale, but adds nothing to their natural history.

Anderson's classification is less formal than Klein's and is hardly an improvement upon it. The general accuracy of his natural history notes, however, and his earnestness and instinct for suspecting errors, though he could not always prove them such, are especially noteworthy. His only contributions to the natural history of species of whalebone whales occurring in American waters are the notes on the Greenland whale, *B. mysticetus*, which he had from the whalers, and possibly the description of *B. physalus* (?), under the name of Jupiter-fish.

Brisson's Règne Animal, published in 1756, contains mention of the species described by earlier authors, but no new information. All the whalebone whales are included in the genus *Balæna.* The species to which American localities are assigned are the "common Greenland whale" (= *Balæna mysticetus*), "the whale of New England" (= the Humpback of Dudley), and "the whale with six humps" (= the Scrag whale of Dudley). To these is added "the Gibbar," which is "frequently found in India and in the New World." The synonymy given in connection with this species includes most of the natural history writers who preceded Brisson, and it is not clear from which of them he derived the information that it occurred in America, though probably he took it from Klein, who in turn refers back to Dudley's account of the Finback, in the *Philosophical Transactions.*

The next work to be considered — the tenth edition of Linnæus's Systema Naturæ (1758) — though it marks the beginning of a new period as regards zoölogical classification and nomenclature, is of very little importance in relation to American cetology. But four species of baleen whales are mentioned, and the statement that *Balæna mysticetus* "lives in the Greenland Ocean" is the sole allusion to anything American. Even this may refer to Spitzbergen rather than to Greenland proper, or "Old Greenland." The twelfth edition (1766) mentions that *Balæna physalus* "lives in the European and American Ocean,"[2] but nothing

[1] *Philos. Trans.*, I, 1665, No. 1, p. 12.

[2] Page 106.

else of interest in the present connection. The various editions of the Systema after the twelfth, published in German, Dutch, English, etc., contain no original American matter on cetaceans, and, except Gmelin's (1788), no improvements as regards classification.

The earliest is Houttuyn's Dutch translation (1762), which appears to have no original information. All the baleen whales remain together under the head of *Balænæ*. The Linnæan species *mysticetus*, *physalus*, *boops*, and *musculus*, are described and commented on under their Latin names, after which occurs the "Neiuw Engelandsche Penvisch" and the "Knobbel Visch." These are Dudley's Humpback and Scrag whales, but our author obtains his knowledge of them through Brisson and Anderson. Farther on we come upon Acosta's fable of the Indians killing whales by plugging their blowholes, which is inserted without comment or indication of its origin.[1]

The only American references in Boddaert's edition (1772), are as follows: "Vinvisch" (*a*) with two blowholes, and a knob on the back. Lives in New England. "Knobbelvisch" (*b*) whale, with two blowholes and six knobs on the back. These are, of course, Dudley's Humpback and Scrag whales.[2]

In 1773 Müller published an annotated edition of the Systema, based on the twelfth edition and the work of Houttuyn. He has the four Linnæan species of whalebone whales, all in the genus *Balæna*, and adds three others (without Latin names) which he found in later authors. Two of these are Dudley's Humpback and Scrag whales, under the names of "Pflockfish" and "Knotenfish," which Müller doubtless knew only indirectly through Anderson, or some other writer.[3]

Gmelin's edition of 1788, or the thirteenth Latin edition, is considerably fuller than the tenth or twelfth, but contains only one added species of whalebone whale, —*Balæna gibbosa*. This is made up of Dudley's Scrag whale and Humpback combined, though all the references are at second hand. The two forms are designated as *a*. and *b*., but not named as varieties. It is an interesting question whether the name *gibbosa* can be applied to the Humpback. Another nominal species included with the baleen whales is the *Balæna rostrata* of Müller's Prodromus. This is, however, probably the *Hyperoödon*.[4] The Nordcaper is included as "*b*," under *Balæna mysticetus*, but without a Latin varietal name; and Egede, Anderson, and Cranz are quoted in the synonymy.[5]

In 1800 William Turton published an English translation of the Systema from Gmelin's edition of 1788. Only two baleen whales have American habitats assigned to them, *B. physalus* ("Fin-fish"), which inhabits "the American and European seas"; and *B. gibbosa*. This latter is called "Hump whale" by Turton and is said to inhabit the "coasts of New England." It is made by uniting Dudley's

[1] HOUTTUYN, F., Natuurlyke Historie volgens Linnæus, 1, pt. 3, 1762, pp. 441–500.

[2] BODDAERT, P., Kortbegrip van het zamenstel der Natuur, van den Heer C. Linnæus, 1, pt. 1, 1772, p. 93.

[3] MÜLLER, P. L. S., Des Ritters Carl von Linné vollstandiges Natursystem, 1, 1773, p. 493.

[4] See *Proc. U. S. Nat. Mus.*, 21, 1898, p. 633.

[5] GMELIN, J. F., Systema Naturæ, 13th ed., Leipzig, 1, 1788, pp. 223–226.

Humpback and Scrag whales under one name as in Gmelin's work. Turton omits all bibliographical references.[1]

While these various editions and translations of Linnæus's works were in course of publication, numerous other systematic works on a more or less independent basis made their appearance. One of the earliest of these was O. F. Müller's Prodromus of the Zoölogy of Denmark (including Greenland), published in 1776.[2] It is a list of species under Latin binomials and polynomials, or diagnoses, with the Norwegian, Icelandic, and Greenlandic names added. The baleen whales are all included in the genus *Balæna*, and the following have Greenlandic names: *B. mysticetus*, Arbec or Arbavirksoak [Bowhead]; *B. physalus*, Keporkak,[3] or Keporkarsoak [Finback]; *B. albicans*, Killelluak [White whale].

The next important systematist, Erxleben, prefaces the list of cetacea in his excellent Systema Regni Animalis (1777)[4] with the remark that the species are but imperfectly known. The baleen whales are all retained in the genus *Balæna*, and the species are the Linnæan ones with the addition of *B. gibbosa*. Of *B. mysticetus* he gives the habitat as toward the North Pole, chiefly about Greenland and Spitzbergen, and among his numerous authorities cites Egede, Anderson, and Cranz. He is in doubt about the Nordcaper, and does not separate it formally from *mysticetus*. *B. physalus* is given as occurring "in the European and American Ocean," and the authorities cited include Egede (Finne-fiske), Anderson, and Cranz (Finnfisch). Erxleben is in doubt about the Pflockfisch (Dudley's Humpback), but thinks it may belong with *physalus*, which is, of course, incorrect. The habitat given is "about New England." He cites it at second hand from Klein, Anderson, and others. The habitat of *B. boops* is in "the northern ocean." Anderson and Cranz (Jupiterfisch) are cited among the authorities. *B. gibbosa* is Dudley's Scrag whale, which he takes at second hand from Klein, Anderson, and other compilers. No habitat is given.[5]

Three years later, in 1780, Otto Fabricius, who was for several years a missionary in Greenland, published his well-known Fauna Grœnlandica, a very concise and judicious work, and one whose influence on zoölogical nomenclature has continued to the present day. In treating of the cetaceans it is hardly to be expected that he would escape errors entirely, especially considering the backward state of cetology at the time, but his descriptions are for the most part remarkably clear.

[1] For Czenpinski's Totius Regni Animalis Genera in Classes et Ordines Linnæana methodo digesta, 1778, see Allen's Bibliography, p. 468, No. 346.

[2] Müller, O. F., Zoölogiæ Danicæ Prodromus, 1776, pp. viii, 6–8.

[3] On p. viii of the introduction Müller transfers this name to *B. boops* [Humpback] on the authority of Fabricius.

[4] Pp. 601–611.

[5] Dr. J. A. Allen in his Bibliography of Cetacea, p. 467, No. 341, remarks that *B. gibbosa* of Erxleben is not the Scrag whale of Dudley, "as usually stated, which is one of the 'species obscuræ' not formally recognized." This is an error. The only one of the "species obscuræ" from Dudley cited by Erxleben, on p. 617 is the "*Dudleji Balæna Klein.*" This is Dudley's sperm whale. On the other hand, all the bibliographical citations under *B. gibbosa* and the diagnosis refer back to Dudley's Scrag whale.

The whalebone whales are brought together under the genus *Balæna* as follows: *Balæna mysticetus* [Bowhead], *B. physalus* [Common Finback], *B. boops* [Humpback], *B. rostrata* [Little Piked whale], and *B. musculus*. This last was not known to Fabricius himself, and he remarks regarding it: "A whale known under a Greenlandic name allied to the preceding [*B. boops*], and rarely seen, which indeed its name indicates. I am perplexed regarding the synonyms of it and the wonderful confusion of them among authors; and being denied by fate to see one of them, I am able to determine nothing with certainty."

In 1818 Fabricius gave a further description of the Greenland Humpback, under the name of "Stub-Hval."[1] He treats of its name, external characters and coloration, distribution and migrations, food, uses, enemies and parasites, and synonymy. The figure which accompanies the article, though interesting, is grossly inaccurate in many particulars. It is quite as good, however, as many others of its time. That it was not made use of by compilers subsequently is somewhat singular.

An important list of American cetaceans was published in 1782 in a work whose title—Letters from an American Farmer—one would hardly expect to find in a bibliography of cetology.[2] The author, Hector St. John de Crèvecœur, seems to have had more or less knowledge of the whaling industry from practical experience, and states that he was "well acquainted" with one kind of whale. His list purports to comprise the species known to the people of Nantucket, and reflects an accuracy of knowledge which is remarkable for its time.

"The river St. Laurence whale [he remarks] which is the only one I am well acquainted with, is seventy-five feet long, sixteen deep, twelve in the length of its bone (which commonly weighs 3000 lb.), twenty in the breadth of their tails, and produces 180 barrels of oil."[3]

This is, of course, the Bowhead, and its mention in this manner seems to support the assertion made by Thomas Edge more than a century before (1625), that the Bowhead at a still earlier date was taken in the "Grand Bay of Newfoundland" [Strait of Belle Isle]. See page 11.

De Crèvecœur proceeds: "The following are the names and principal characteristics of the various species of whales known to these people [of Nantucket and Martha's Vineyard]:

"The River St. Laurence whale, just described.

"The disko, or Greenland ditto.

"The right whale, or seven feet bone, common on the coasts of this country, about sixty feet long.

[1] Fabricius, O., Zoologiske Bidrag. 2det Bidrag. Om Stub-Hvalen, *Balæna Boops*. *K. Danske Videns. Selsk. Skrivter*, 6, 1818, pp. 63–83, 1 pl. (unnumbered), fig. 1.

[2] Letters from an American Farmer describing the British Colonies in North America, London, 1782, pp. 167–169. Allen (Bibliog., p. 472), states that "In the French edition of 1767 [*lege* 1787], the letter about the whale-fishery is dated 'Nantucket, 17 Octobre, 1772.'"

[3] *Op. cit.*, p. 167.

"The spermaceti whale, found all over the world, and of all sizes; the longest are sixty feet, and yield about 100 barrels of oil.

"The hump-backs, on the coast of Newfoundland, from forty to seventy feet in length.

"The finn-back, an American whale, never killed, as being too swift.

"The sulphur-bottom, river St. Laurence, ninety feet long; they are but seldom killed, as being extremely swift.

"The grampus, thirty feet long, never killed on the same account.

"The killer or thrasher, about thirty feet; they often kill the other whales, with which they are at perpetual war.

"The black fish whale, twenty feet, yields from eight to ten barrels.

"The porpoise, weighing about 160 pounds."

In this same year, 1782, was published Duhamel's great Traité Général des Pêches. He also alludes to the occurrence of Bowheads in the temperate waters of Canada.

"I know that some small whales [Nordcapers] are taken in Iceland, and that some large ones [Bowheads] are found sometimes accidentally in the more temperate Provinces, especially in Canada, where the large whales [Bowheads] are for the most part wounded by harpoons; some even are dead, which leads one to believe that they are whales which, having been chased and wounded in the northern parts, have left their home to retire into other quarters."[1]

What led Duhamel to make this explanation is not evident, but if the Bowhead was really fished for in the Gulf of St. Lawrence, it seems unlikely that wounded and dead whales would be the object of pursuit. Referring to the causes which induced the English to withdraw from the Greenland fishery, Duhamel remarks:

"Others pretend that the Dutch having succeeded in carrying on the fishery [at Greenland] with more economy than the English, the latter have found it more convenient and advantageous to carry on the fishery on the coasts of New England, New York, and Carolina, where they maintain many vessels, which carry the product of their fishery to England. The whales that are taken in these places are smaller than those found in the ice of the north; nevertheless, in proportion to their size, they yield oil quite abundantly."[2]

On page 28 he gives Acosta's story of the Florida Indians, without referring to the former, but remarks: "The truth of this which we have said has been attested by many ocular witnesses, among others, by many officers, who have been ready to establish these facts." This is the first time since 1590, I believe, that any one has been willing to vouch for the truth of Acosta's story.

A writer of this period who labored earnestly, and with some measure of success, to abate the confusion existing in cetology, was the Abbé Bonnaterre, whose Tableau Encyclopédique was published as a supplement to the Encyclopædia

[1] DUHAMEL, Traité Général des Pêches, 4, p. 10.

[2] *Op. cit.*, 4, p. 28.

Méthodique in 1789.[1] He was well acquainted with the literature, conscious of the errors existing, and in his introduction endeavored to impress on his readers the necessity of more accuracy and detail in the descriptions of cetaceans. He seems, however, to have had little personal familiarity with the animals he treated of, and was therefore at a disadvantage in estimating the accuracy or inaccuracy of the naturalists who preceded him. The matter relating to the whalebone whales is almost entirely a compilation, but the scientific names applied to the various species are of interest.

All the whalebone whales are assembled in the genus *Balæna*. The species are as follows:

1. *B. mysticetus*. "Greenland Whale." (P. 1.)

"This species is very common toward the North Pole, in the Greenland and Spitzbergen seas, chiefly beyond the 66th degree, north latitude." (P. 3.)

An excellent general account is compiled from various authors, including Fabricius, but there is no new matter other than a table of measurements of a specimen 48 feet long, reported by Captain de Pagés.

2. *B. glacialis*. "The Nordcaper." (P. 3.)

"Inhabits the northern seas, about Norway and Iceland."

3. *B. physalus*. "The Gibbar." (P. 4.)

"Found in the seas of Greenland, the European Ocean, India, and the New World."

The account of the species is compiled chiefly from Martens, Linnæus, and Fabricius.

4. *B. nodosa*. "The 'tampon' whale." (P. 5.)

"Found in New England."

This is Dudley's Humpback. Bonnaterre quotes from Dudley's account, but does not realize that this is the sole original source, and that all the other authors he cites take their information from it.

5. *B. gibbosa*. "The whale with 'bosses.'" (P. 5.)

"Inhabits the seas about New England."

This is Dudley's Scrag whale, though Bonnaterre takes his information from Anderson and Klein, and is at a loss to understand why the former should assert that it yields as much oil as *B. mysticetus*, while the latter calls it meagre (*B. macra*). This apparent contradiction is due, of course, to the fact that Dudley states that the Scrag whale is "nearest to the Right whale for quantity of oil," while Klein has translated the word "scrag" by *macra*.

[1] BONNATERRE, Tableau Encyclopédique et Méthodique des Trois Règnes de la Nature—Cetologie. Paris, 1789. 4°.

6. *B. boops.* "The Jubarte." (P. 6.)

"Found ordinarily in the Greenland seas, between the 61st and 65th degrees of latitude, about Pamiuk and Pissukbik."

Bonnaterre paraphrases Fabricius's account of *B. boops*, which relates, of course, to the Humpback. He closes with the naïve remark: "Judging from the description of Otto Fabricius, it seems to me that there is a slight defectuosity in the figure which we have given." As the figure given is from Sibbald and represents a Finback rather than a Humpback, the "defectuosity" is not surprising. Bonnaterre also quotes in this place Sibbald's measurements of this same Finback which Linnæus called *Balæna boops.* By thus combining Linnæus's *B. boops* (a Finback) and Fabricius's *B. boops* (a Humpback) Bonnaterre caused confusion which has lasted until the present time. In a recent paper I endeavored to point out the facts in the case.[1] It is somewhat singular that so critical a naturalist as Bonnaterre failed to discover that his *B. nodosa* (from Dudley) and his *B. boops* (from Fabricius) were very closely related, if not identical.

7. *B. musculus.* "The Rorqual." (P. 7.)

"In Iceland, called *Steipe-Reydus.*"

Bonnaterre has the correct Icelandic name in this case. He quotes Sibbald's account and measurements.

8. *B. rostrata.* "Beaked whale." (P. 8.)

"Found in large numbers in the Greenland seas; it frequently visits the seas of Europe."

Bonnaterre quotes Fabricius and Hunter. This is the Little Piked whale, *Balænoptera acuto-rostrata* Lacépède.

Nineteenth Century.

In the opening decades of the nineteenth century decided advances were made in the classification of whales, in the observation of their habits, and in the description of their structure. Lacépède, Scoresby, G. Cuvier, F. Cuvier, Desmarest, Home, Camper, Brandt and Ratzburg, and Fischer were among the most important contributors to cetological literature at this period, but their work has little or nothing to do directly with American species or American observations.

The narrative of Lewis and Clark's memorable expedition to the Pacific coast in 1804–06 contains a few references to whales, which are so brief that they may be quoted here in full. The earliest incident dates from January 4, 1806, when

[1] *Proc. U. S. Nat. Mus.*, 21, 1898, p. 624.

It is true that Fabricius himself adopted Linnæus's names, and cited the Systema Naturæ, but it is not likely that he had access to the sources from which the latter derived his facts, as Bonnaterre did.

the travellers were on the Oregon coast near the mouth of the Columbia River, and is as follows:

"Friday [January 4, 1806]. At eleven o'clock we were visited by our neighbor the Fia, or chief Comowool, who is also called Coone, and six Clatsops. Besides roots, and berries, they brought for sale three dogs and some fresh blubber. . . . The blubber, which is esteemed by the Indians an excellent food, has been obtained, they tell us, from their neighbors the Killamucks, a nation who live on the seacoast to the southeast, and near one of whose villages a whale had recently been thrown and foundered.

". . . We continued for two miles along the sand beach [Jan. 8, 1806]; and after crossing a creek [Nehalem River, Oregon], eighty yards in width, near which are five cabins, reached the place where the waves had thrown the whale on shore. The animal had been placed between two Killamuck villages, and such was their industry, that there now remained nothing more than the skeleton, which we found to be one hundred and five feet in length."[1]

The second note refers to the Oregon coast in general, and is as follows:

"The whale is sometimes pursued, harpooned and taken by the Indians, although it is much more frequently killed by running foul of the rocks in violent storms, and thrown on shore by the action of the wind and tide. In either case, the Indians preserve and eat the blubber and oil; the bone they carefully extract and expose to sale."[2]

The systematic treatises of Dr. J. E. Gray, beginning with the Spicilegia Zoölogica in 1828, and ending with the Supplement to the Catalogue of Seals and Whales in the British Museum in 1871,[3] cover all groups of cetaceans and include many species founded on American material and observations. Gray was accustomed to establish genera and species on quite slight differences, real or fancied, and in so difficult a group as the Cetacea this tendency had full play. A large number of the species which he recognized were rejected by the more conservative cetologists who were contemporary with him, or followed him, but in the case of some genera there is no doubt that the condensation has been too great. Among the genera and species which Gray recognized or established are some from American waters. In his Supplement, which contains his last published views, they are as follows:

Family 1. Balænidæ.
Balæna mysticetus. [Greenland Whale.]
Eubalæna? cisarctica. "Inhab. Atlantic."
[From Cope. The Biscay whale he makes a separate species, *Hunterius biscayensis*.]
Family 2. Agaphelidæ. Scrag Whales.
Agaphelus gibbosus. "Inhab. North Atlantic."
[From Cope and Dudley.]
Rhachianectes glaucus. "Inhab. California, San Francisco."
[From Cope.]

[1] History of the Expedition of Captains Lewis and Clark, 2, 1814, pp. 104, 110–111. Coues's edition has the following note (2, p. 750): "Clark I 99 erases '105' and gives no dimensions."

[2] *Op. cit.*, p. 196.

[3] GRAY, J. E., Supplement to the Catalogue of the Seals and Whales in the British Museum, 8°, 1871.

Family 3. Megapteridæ. Humpbacked Whales.
Megaptera americana. "Inhab. Bermuda."
[From the anonymous writer of 1665 in the *Philos. Transactions*, Dudley, a tracing in the British Museum, and Hartt's Geology and Physical Geography of Brazil.]
Megaptera osphyia. "Inhab. Atlantic."
[From Cope.]
Megaptera versabilis. "Inhab. North Pacific, California coast."
[From Cope.]
Eschrichtus robustus. "Inhab. North Sea, coast of Devonshire, Sweden, Atlantic."
[The only American reference is Cope's statement that there is a ramus of an under jaw in the museum of Rutgers College.]
Family 4. Physalidæ.
Physalus antiquorum. "Inhab. North Sea, Greenland, Hampshire, etc."
Sibbaldius sulphureus. "Inhab. North Pacific, northwest coast of America, California."
[From Cope.]
Sibbaldius tectirostris. "Inhab. North Pacific" [really Atlantic].
[From Cope.]
Sibbaldius tuberosus. "Inhab. northeast coast of America."
[From Cope.]
Balænoptera velifera. "Inhab. Oregon, California, Queen Charlotte's Sound."
[From Cope.]

In all this, it will be observed, there is but one species which Gray himself established, *Megaptera americana*. For this the only original material he had was a tracing of unknown origin. It is singular that he does not give *M. longimana* an American habitat, as in the Catalogue of 1866 he mentioned four specimens from Greenland as being in the British Museum. They were from Eschricht's collection.

In 1870 Dr. Gray published an article entitled "The Geographical Distribution of the Cetacea,"[1] which is a kind of confession of faith as regards the discrimination of species and allied matters. It presents in the clearest manner Dr. Gray's views on these subjects, and is accompanied by an extensive list of species, which latter are divided among three geographical areas: (1) the northern and temperate seas, (2) the tropical seas, and (3) the south, or southern temperate seas. The list contains no less than 50 species and varieties of baleen whales. It is full of errors and misconceptions, and is chiefly interesting as showing Dr. Gray's point of view at the time it was published. Much more can doubtless be said in favor of that part of the list which relates to the *Delphinidæ* than that which includes the *Balænidæ*.

In Feb., 1874, Dr. Gray published a brief note on the *Megaptera bellicosa* of Cope,[2] in which he expressed the opinion that the species was a very distinct one, but that the name was a synonym of *Megaptera americana* Gray.

Frederic Cuvier's Natural History of Cetaceans, published in 1836,[3] contains

[1] Gray, J. E., The Geographical Distribution of the Cetacea. *Ann. and Mag. Nat. Hist.* (4), 6, 1870, 387–394.

[2] Gray, J. E., On the Bermuda Humpbacked Whale of Dudley (*Balæna nodosa*, Bonnaterre; *Megaptera americana*, Gray; and *Megaptera bellicosa*, Cope). *Ann. and Mag. Nat. Hist.* (4), 13, 1874, p. 186.

[3] Cuvier, F., De l' Histoire Naturelle des Cétacés, 1836.

a few references to American baleen whales. The work is a comprehensive one, and contains a summary of most of the important observations previously published. The treatment of species is conservative, but the conclusions reached have not all been confirmed by later researches. The whalebone whales are placed in two genera, "the rorquals" and "the whales." For the former the new genus *Rorqualus* is established, and the species recognized are *R. boops*, *R. musculus*, and *R. antarcticus*.

Under *Rorqualus*, Cuvier mentions the observations of Dudley, Egede, and Anderson, which have to do with American whales. Regarding Dudley he says:

"Dudley speaks also of two whales with folds under the body, and a dorsal protuberance: the 'Finback whale,' of which the dorsal fin is $2\frac{1}{2}$ feet long, and the pectoral fins from 6 to 7 feet; the 'Humpback whale,' which, in place of a fin, has a simple hump a foot high and pointed behind. Its pectoral fins are sometimes 18 feet long and very white. But these ideas, derived from Dudley, seem to have been poorly appreciated up to this time."[1]

This is an odd remark, as Cuvier himself seems not to have appreciated the singularity of a whale with pectoral fins "18 feet long and very white." He makes no further reference to it, except to remark that "the 'Humpback whale' of the same author [Dudley] is not a whale, but a rorqual; for he says, in explicit terms, that this cetacean has longitudinal folds — like that of which he speaks immediately before (the 'Finback whale') — on the belly and sides, from the head to the origin of the pectoral fins."[2]

Regarding Dudley's description of the "Scrag whale" Cuvier remarks:

"For ourselves, we only see in it a very insignificant note, which probably contains an error in citing the protuberances of the back as osseous; it only serves to arouse suspicions as to the value of the characters drawn from these protuberances, and further to make it doubtful whether this cetacean was not a rorqual, for the 'Finback whale' to which Dudley compares his 'Scrag whale' is a genuine rorqual."[2]

Cuvier rejects the Nordcaper as a separate species.

The epoch-making works of Eschricht cover the period from 1840 to 1873. He investigated many phases of cetology beyond the scope of the present paper. On account of the diversity of the subjects treated of and the immense mass of facts accumulated, it is very difficult to summarize his work. The larger part of his investigations relate to baleen whales, and much of his material was American, having been obtained by Captain Holböll in Greenland. This material consisted chiefly of specimens of the Greenland Humpback, both skeletons of adult individuals, fœtuses, and anatomical preparations. Many of the skeletons were distributed to other European museums beside those of Copenhagen, and the descriptions of the Humpback published by Van Beneden and other European writers are drawn from these American specimens.

The main body of Eschricht's work is the series of six essays in the Royal

[1] Cuvier, F., De l'Histoire Naturelle des Cétacés, 1836, p. 309.

[2] *Op. cit.*, p. 355.

Danish Scientific Society's *Afhandlinger* and *Skrifter*, 1845–1849.[1] Being in the Danish language, they are a sealed book to many zoölogists, who either lack the opportunity, or have not the inclination, to acquire that tongue. For this reason they were not appreciated by Eschricht's contemporaries as they might have been. Feeling this himself, he undertook to republish the series in German with many changes and additions, but the German edition was never completed. More will be said of it later. The essays themselves were preceded by several short papers, beginning in 1840, in which the scope and objects of the investigations were described. The essays may be summarized as follows:

Essay 1.—*Remarks on the earlier and present phases of cetology.*

In this essay Eschricht treats chiefly of the history of different departments of cetology, beginning with the *Delphinidæ*. The genus *Hyperoödon* is briefly considered, and afterwards he treats of the sperm whale in much detail. Next follow the baleen whales, of which there are stated to be two groups—Right whales and Finbacks. Regarding the former, Eschricht remarks: "Since Cuvier's time two kinds are usually distinguished, the northern *Balæna mysticetus*, and the southern, *B. australis*." At this date Eschricht seems not to have discovered that the Nordcaper was distinct from *B. mysticetus* or even from the Humpback.

He next takes up the question of geographical distribution, notes the reduction in numbers of whales in the Gulf of St. Lawrence, but combats the theory that the distribution area shrinks at any time. He refers to the distribution of the Right whale in the South Atlantic, and quotes Holböll as to the migrations of the Greenland whale on the west coast of Greenland. He mentions Dudley and gives the seasons for the whale fishery and other details.

Next come the Finbacks, including under that head the Humpbacks. He describes their distribution; mentions Sibbald, the anonymous writer in the *Phil. Trans.*, etc.; cites their use as a food resource by Greenlanders and Norwegians, and their relative value for oil, etc. He describes the early modes of fishing for large whales in Norway and elsewhere; quotes Fabricius's account of the Humpback fishery in Greenland and also that of Holböll; states that the Greenlanders cared little for the Finbacks, but that Humpbacks have been taken regularly at Greenland and also at Bermuda. He then takes up the question as to whether the Basque fishery of the sixteenth and seventeenth century may not have been for Finbacks,

[1] 1. Bemærkninger over Cetologiens tidligere og nærværende Skjebne. *Dansk. Videns. Selsk. natur. og math. Afhandl.*, 11, 1845, pp. 129–202.

2. Anatomisk Beskrivelse af de ydre Fosterformer hos to nordiske Finhval-Arter, med Anvendelse paa Physiologien og Zoologien. *Do.*, pp. 203–279.

3. Om Fosterformerne i Bardehvalernes Ernaerings- og Forplantelsesredskaber. *Do.*, pp. 281–320, pls. 1–4.

4. Om Næbhvalen. *Do.*, pp. 321–378, pls. 5–8.

5. Finhvalernes Osteologie og Artsadskillelse. *Do.*, 12, 1846, pp. 225–396, pls. 9–16.

6. Udbytte paa en Reise gjennem det nordvestlige Europa i Sommeren 1846, som Tillæg til de foregaaende Afhandlinger. *Dansk. Videns. Selsk. Skrifter, 5te Raekke, natur. og math. Afd.*, 1, 1849, pp. 85–138.

and leaves it with the remark that neither Right whales nor the Common Finback seem to fit the accounts. He states that there was apparently no regular coast fishery formerly from which opportunity could be had to investigate the Finbacks, and hence knowledge of them depended on occasional strandings. He gives a brief account of specimens examined on various parts of the coast of Europe at different dates. He then takes up the history of the development of knowledge regarding Finbacks, citing Dudley, Sibbald, Cuvier, Holböll, etc. Eschricht concludes that one may be convinced that there are many species of Finbacks in the south seas and the north, and states that the characters of these will be treated of in subsequent essays.

He calls attention to the defects of anatomical descriptions, due to imperfect material, and to the use of fishery stations, especially in Greenland and near Bergen, and enumerates the advantages to be obtained. He then mentions the material obtained by him from Holböll and Christie (in Bergen).

Essay 2. — *Anatomical descriptions of the external form of the fœtuses of two species of Northern Finbacks, with application to physiology and zoölogy.*

The two species of Finbacks are the Little Piked whale, *Balænoptera acuto-rostrata*, and the Greenland Humpback. Though of much importance, the descriptions are not germane to the purpose of the present paper, but the essay ends with a section "on the use of whale fœtuses in the determination of species," in which the characters of Fabricius's *B. boops* and Rudolphi's *B. longimana* are carefully considered, and the conclusion reached that "the *B. longimana* of Rudolphi and Brandt really is specifically identical with Fabricius's *B. boops*."

Essay 3.—*On the fœtal forms of the alimentary and reproductive apparatus in the baleen whales.*

Essay 4.—*On Beaked whales* [*Hyperoödon*].

These two essays do not concern us in the present connection. Their contents are sufficiently indicated in the titles.

Essay 5.—*The osteology and discrimination of species of Finback whales.*

In this long and important essay the skeletons of *Balænoptera acuto-rostrata* and the Greenland Humpback are minutely described and many bones figured. Eschricht then takes up the question of the specific characters of the two whales above mentioned and enumerates them *seriatim*, after which he enumerates the differences which seem to separate the Little Piked whale, or Tikagulik of Greenland, from the Vaagehval (*B. acuto-rostrata*) of Norway. Regarding this he says that as to whether they are specifically identical he has many times changed his opinion. Later he remarks: "As the *Vaagehval* and *Tikagulik* agree fully, especially in regard to the color of the baleen and the number of vertebræ, as well as in the whole and every part of the different sections of the vertebral column, I have not thought that the above-mentioned differences can be considered as sufficient ground on which to establish specific distinctness." He then describes a Common Finback which stranded on the coast of Norway in 1841, and discusses its affinities, and afterwards enumerates the kinds of whales found in Greenland waters and known to the Eskimos, and quotes a description and measurements by Möller of a Finback

stranded at Godhavn, Greenland, in 1843. He discusses Möller's data and describes and figures one of the pectoral fins of this specimen which was sent to him, and connects the species with Holböll's "Kepokarnak" and the Ostend Finback of 1827. He sums up the whole section as follows: That it is demonstrated that there are at least three different species of Finbacks in the northern seas: (1st) "In the long-handed group, the Greenland 'Keporkak,' *B. longimana;* in the short-handed, (2d) the Norwegian 'Vaagehval,' *B. minor*, and (3d) the common, large short-handed Finback, *B. boops.*" That there are as good as certain (4th) a special large, short-handed species, *B. musculus*, and at least highly probable (5th) the Greenland "Kepokarnak," and not improbable (6th) the Greenland "Tikagulik" or *B. rostrata* Fabr., distinct from the Norwegian "Vaagehval." Finally, Eschricht passes in review all the principal observations on the geographical distribution of these supposed species, including Holböll's Greenland researches, and the early accounts concerning the Bermudas in the *Philosophical Transactions.*

Essay 6.—*Results of a journey through northwestern Europe in the summer of 1846, as a supplement to the preceding treatises.*

This essay is divided into three sections, one on the Beaked whales, another on the Humpbacks, and a third, on short-handed, or true, Finbacks. Eschricht visited several of the more important museums of Europe, notably those of London, Paris, and Berlin, and examined many of the skeletons described by other authors, including the type of *Megaptera longimana*, and other very important specimens. He not only comments on these, but reviews and revises his earlier observations, and this essay may be considered as embodying his final views regarding the species of Humpbacks and Finbacks. The paper is of much importance in the present connection, as the Greenland species are commented upon no less than the European ones, and at this time Eschricht had made actual comparisons of specimens of both.

As already stated, Eschricht became apprehensive that his work would not receive the attention it deserved, on account of its publication in Danish, and hence resolved to republish it in German.[1] The German edition, he tells us, is not to be regarded as a translation, but as a new working over of the whole material, with a more orderly presentation of data and conclusions. Certain it is that the two editions differ widely, and much that is in the Danish is not in the German. This is due in part to the fact that the latter was never completed. Only the first volume of the three which Eschricht planned was completed as he intended. The second, fourth, and fifth Danish essays are the ones most nearly reproduced in the German edition.

In the latter, as in the former, the principal data of importance in the present connection are the descriptions of the Finbacks and Humpbacks of Greenland, and the opinions of Eschricht based on his comparisons of Greenland and European specimens of these whales. In addition to Eschricht's own researches, translations are given of two communications of Holböll on Greenland baleen whales, and one by Motzfeldt relating in part to the same subject.

[1] Eschricht, D. F., Zoologisch-anatomisch-physiologische Untersuchungen über die nordischen Wallthiere, 1te Band, Leipzig, 1849.

The great work on the Greenland Right whale published by Eschricht and Reinhardt in 1861[1] interests us chiefly on account of the discussion of the relation of *B. mysticetus* to the Nordcaper, in the course of which numerous facts relating to the Right whale of the east coast of temperate North America are commented upon.

In 1858 Eschricht published an article on a new method of studying the Cetacea,[2] in which he called attention to the desirability of making observations at the various whale-fishing stations in different parts of the world. Among the stations mentioned are those in Davis Strait, where Captain Holböll obtained so much valuable material for Eschricht's researches. The manner in which this material was obtained is described, and a summary given of the species frequenting Davis Strait, their migrations and other data.

Eschricht's essay on the geographical distribution of the northern whales in earlier times and at present,[3] which was published in 1849, relates chiefly to the Greenland whales. It is one of the earliest, as well as one of the best, treatises on the distribution of the cetaceans. His paper entitled "Researches on the Distribution of the Cetacea in the Northern Seas,"[4] published in 1864, is also almost entirely devoted to the Greenland whales, and treats particularly of the migrations of *Balæna mysticetus* in Davis Strait.

In a work called "Newfoundland in 1842," Sir Richard Bonnycastle devoted a chapter to cetaceans, in which he calls attention to the whale fishery carried on there, and notes various cetaceans he has observed about the island. The article is unfortunately largely taken up by citations from Scoresby, Dewhurst, and other authors, and it is not always clear whether the statements made are based on Bonnycastle's own observations or derived from the works mentioned. Deprived of extraneous matter, the article, in so far as it relates to baleen whales, amounts to this — that Sir Arthur saw a "*B. acuto-rostrata*, or sharp-nosed whale," within a day's sail of St. John in 1840; that the commonest species in Newfoundland waters, as he believes, is the "*B. jubartes*, or pike-headed finner," with a dorsal fin 2½ feet high, and which feeds upon capelin, etc.; that whales of various sizes and kinds are common in the St. Lawrence, about Gaspé, and on the Labrador coast; that he repeatedly saw a "black and grey" whale in the Bay of Seven Islands, St. Lawrence River, in 1831; that on the 23d of July, 1840, at the entrance to Conception Bay, Newfoundland, he saw a "pipe-headed whale" about twenty-five feet long, with a brown back and white belly; that on July 24, 1840, he saw "whales innumerable" in Conception Bay and continued to see some of them all the way to St. John's.[5]

[1] ESCHRICHT og REINHARDT, Om Nordhvalen. *Dansk. Vid. Sels. Skrif.*, 5, 1861, 433–589. Translation in Ray Society Publications, under the title of "Recent Memoirs on the Cetacea." Edited by Sir Wm. H. Flower.

[2] ESCHRICHT, D. F., Sur une nouvelle Méthode de l'Étude des Cétacés. *Comptes Rendus Acad. Sci. Paris*, 47, 1858, pp. 51–60.

[3] ESCHRICHT, D. F., Om de nordiske Hvaldyrs geographiske Udbredelse i nærværende og i tidligere Tid. *Forhandl. Skand. Naturforsk. 5te Möde*, 1849, pp. 103–118, pl. 1.

[4] ESCHRICHT, D. F., Recherches sur la Distribution des Cétacés dans les Mers Boréales. *Ann. Sci. Nat., Zoöl.*, 1, 1864, pp. 201–224.

[5] BONNYCASTLE, A., Newfoundland in 1842, 1, pp. 239–255.

Jouan's memoir on the Right whales and Sperm whales, 1859,[1] is an excellent summary of observations on these forms, with some references to Finbacks, Humpbacks, Blackfish, etc. Though largely based on the data furnished by American whalers, it does not relate especially to whales in American waters. Jouan discusses the different kinds of whales, but is not fortunate in his discrimination of species. Of "*B. nodosa* Lacep." he remarks: "This is a Humpback, or perhaps a whale that is found in California, which the whalers designate by the names of 'California Grey,' or 'Californian Ranger.'" Of the Humpback, which he places among "les baleinoptères," he remarks:

"The Humpbacks are encountered in very great numbers in the same places as the Sperm whales and Right whales; but it is especially on the coasts of Chili, Peru, California, and New Zealand that they are found most abundant.

"We have seen the bay of San Carlos de Monterey, California, literally covered with these great cetaceans which swim like porpoises, going down head foremost, and elevating their broad tails in the air."

Pierre Fortin's report on the fisheries of the Gulf of St. Lawrence for 1861 and 1862, published in 1863 by the Fisheries Department of Canada, contains, at page 109, a list of cetacea, etc., of the Gulf. The species mentioned are the Right whale, Humpback, Common Finback, and Sulphurbottom. The notes on these whales occupy two pages, the facts cited being of some interest, but hardly as definite as could be desired. His report for 1865 (p. 49) contains a note on the whale fishery, but very little regarding the whales. The Gulf fishery is also the subject of a few paragraphs in the report for 1867 (p. 24).

The cetological writings of P.–J. Van Beneden, both in number and in scope, greatly surpass those of any other zoölogist, and in importance rank with those of Eschricht and Flower. Though he compiled much from the writings of others, and repeated the same matter many times in different publications, the amount of original work he accomplished in cetology constitutes a monument of which any zoölogist might be proud, and Van Beneden built himself many such. He had but little American material at command, but was familiar with the writings of American cetologists and included their observations in his summaries, frequently commenting on them at some length, and expressing opinions of his own regarding the facts brought forward.

His Natural History of the Cetaceans of the Seas of Europe, published in 1889,[2] which is a combination of several papers on different groups, published between 1886 and 1889, contains references to all of Cope's and Scammon's species of baleen whales, and to some American material in European museums, but nothing not already in the Ostéographie and other earlier publications. In 1864, Van Beneden published the results of a comparison of the skeletons of the Humpback whales of

[1] Jouan, H., Mémoire sur les Baleines et les Cachalots. *Mém. Soc. Imp. Sci. Nat. Cherbourg*, 6, 1859, pp. 1–40.

[2] Van Beneden, P.–J., Histoire Naturelle des Cétacés des Mers d'Europe. Bruxelles, 1889. 8°.

the Cape of Good Hope and of Greenland.[1] He concludes that they represent two very distinct species. The figures and much of the matter of this article were afterwards re-published in his Histoire Naturelle des Cétacés. In 1868, Van Beneden published an essay on the geographical distribution of the Right whales,[2] accompanied by a chart on which are represented the distribution areas of the various species of *Balæna*. The chart shows the range of *B. biscayensis* as extending to the east coast of the United States. (See p. 56.)

Dr. Gray published[3] criticisms of Van Beneden's map, contending that it was based on insufficient material and thus of no profit to science. In sustaining this contention he referred to most of the earlier American observations, including those of Dudley, Maury, Cope, etc., and commented on them at some length. In the same year, 1868, Van Beneden replied to the criticisms of Gray. One of the points involved is the relation of *B. biscayensis* to *B. cisarctica*. Regarding this Van Beneden remarks:

"But the most important question, and that on which Dr. Gray and myself are not in accord, is that of knowing whether the *Balæna biscayensis* is the same as that which Professor E. D. Cope has made known under the name of *Balæna cisarctica*, from a skeleton preserved in the Philadelphia museum. Dr. Gray says 'Certainly not'; I, on the contrary, think it is. . . . The reasons on which Dr. Gray depends in saying 'Certainly not,' are, in my opinion, far from having the importance which he would accord them. These reasons are: That the *Balæna cisarctica* has 14 pairs of ribs and that the first is not bifid,—it is singleheaded." Van Beneden's conclusion is: "We shall continue to regard the *Balæna cisarctica* of Professor Cope as being a synonym of *Balæna biscayensis*."[4]

The monumental work of Van Beneden and Gervais on the Osteography of the Cetacea,[5] (text dated 1880, but began to appear in 1868), is based chiefly on Old-World material and observations, but some American specimens are mentioned and described and the species established by American zoölogists are briefly discussed. The ear-bone of a specimen of *Balæna cisarctica* Cope is described and figured. Reference is made to the occurrence of several skeletons of *Megaptera* from Greenland in European museums, and the figures of the skeleton of *M. longimana* are probably from this material, though it is not explicitly so stated. The same is true of the description and of a part of the figures of *B. acuto-rostrata*. A brief comparison is made between the various nominal species of baleen whales established

[1] Van Beneden, P.–J., Le Rorqual du cap de Bonne-Espérance et le Képorkak des Groenlandais. *Bull. Acad. R. Belg.* (2), 18, 1864, p. 389.

[2] Van Beneden, P.–J., Les Baleines et leur Distribution Géographique. *Bull. Acad. R. Belg.* (2), 25, 1868, pp. 9–21.

[3] On the Geographical Distribution of the *Balænidæ*, or Right Whales. *Ann. and Mag. Nat. Hist.* (4), 1, 1868, p. 242; also (4), 6, 1870, pp. 193–204.

[4] Van Beneden, P.–J., La Première Côte des Cétacés. *Bull. Acad. R. Belg.* (2), 26, 1868, pp. 7–16, pls. 1–2.

[5] Van Beneden, P.–J., and Gervais, P., Ostéographie des Cétacés, vivants et fossiles. Atlas, 1868–1879. Text, 1880.

by European and American authors, and opinions expressed as to their identity. The text concludes with the chart previously mentioned, on which is indicated the distribution of species of *Balæna* in North American waters. The portion of this work relating to the genus *Balæna* having been finished by 1870, Dr. J. E. Gray took occasion to criticise it severely,[1] and in the course of his remarks touched upon certain American species. He refers to the objections which have been made to his own method of treating species and higher groups, and cites arguments sustaining his position. He criticises the chart showing geographical distribution, above mentioned, and comments on the meagreness of the material on which Van Beneden and Gervais based conclusions in some instances. He gives a list of North Atlantic species of *Balæna* which he considers valid, and mentions the species of the North Pacific which have received names. Much of the criticism contained in this paper was doubtless just or at least useful, but later studies have not on the whole sustained Gray's contentions regarding species and other matters. The American species cited are those of Cope, both Atlantic and Pacific, special mention being made of *Balæna cisarctica*, *Agaphelus gibbosus*, and *Rhachianectes glaucus*.

In the same year Van Beneden replied to the criticisms of Gray on the *Balænidæ* of the Ostéographie des Cétacés[2] and in that connection made the following remarks regarding American material:

"This whale [Nordcaper] which was hunted in the English Channel was the first destroyed, and if by hazard it presents itself still in Europe, it is always in the middle of winter. It was in February, 1854, that the last one made its appearance. We cannot say positively at what time of the year the whale which Prof. A. Agassiz has prepared for the Cambridge museum was captured, but we have reason to believe it was in summer. . . . We shall have therefore for this second species, as for the first [*B. mysticetus*], fixed winter and summer stations. . . . The whale captured on the coast of America and to which Prof. Cope has given the name of *Balæna cisarctica* is, we believe, the same which formerly made its regular winter station in Europe. Dr. Gray does not share this opinion. To solve this interesting question directly by observation we addressed ourselves to Prof. Cope, who has kindly sent us from Philadelphia one of the ear-bones of his new species. We requested Prof. Reinhardt, of Copenhagen, to compare this ear-bone with that of the skeleton from Pampelune in his museum, the only one actually known in Europe. Although the first bone belongs to an adult and the second to a young animal, which renders comparison difficult, it is, however, evident, according to Prof. Reinhardt, that there is nothing which would lead one to suppose that the bones belonged to distinct species."

Van Beneden closes with four theses, of which three are as follows:

(*a*) "There exist two species of true whales (Right whales) in the North Atlantic and on the coasts of Greenland,—one the common whale, called also the Greenland whale, and the other the *Sarde* or Nordcaper.

[1] Gray, J. E., Observations on the Whales described in the Ostéographie des Cétacés of MM. Van Beneden and Gervais. *Ann. and Mag. Nat. Hist.* (4), 6, 1870, pp. 193–204.

[2] Van Beneden, P.–J., Observations sur l'Ostéographie des Cétacés. *Bull. Acad. R. Belg.* (2), 30, 1870, pp. 380–388.

(*b*) "Each of these two species has its stations at fixed times, and they do not frequent the same waters; the southern limits of one are the northern limits of the other.

(*c*) "It is the same species which visits the coasts of Europe in winter and the coasts of America in summer."

In a paper entitled "A Word regarding the Whale of Japan," published by Van Beneden in 1875,[1] are a few interesting comments on the whales of the North Pacific which may be supposed to visit the west coast of North America, and on a collection of whalebone made by Capt. Scammon and deposited in the Vienna museum by Dr. Steindachner.

A paper published by Van Beneden in 1878 under the title of "The Geographical Distribution of the Finbacks,"[2] contains numerous allusions to American material and observations, and an expression of opinion regarding the identity of various species of the east and west coasts of America described by Cope, Scammon, and other American writers.

In 1880 Van Beneden published a brief account of the Right whale taken in Charleston harbor on Jan. 7th of that year. He remarks concerning it:

"We connect this whale, without hesitation, with the species which the Basques hunted for centuries in the English Channel, the North Sea, and the Atlantic, and of which only a few individuals remain; the species is almost completely exterminated. . . . We have been able to assure ourselves that the *Balæna cisarctica* is the same which in winter visits the shores of Europe."[3]

In 1885 Van Beneden published a note on information he had obtained from Dr. Holder of a small school of Right whales which appeared on the Atlantic coast of the United States in the preceding winter. He states that the school consisted of 6 individuals, of which 4 were captured, comprising 3 adults and one young,—the largest 60 feet long. As before, he expressed the opinion that the species is the same as the Basque whale, *Balæna biscayensis*.[4]

In describing a barnacle believed to have been taken from a whale captured in the Gulf of St. Lawrence, or on the coast of Europe,[5] Van Beneden takes occasion to set forth a number of theses regarding the geographical distribution of certain species of *Balæna* and *Megaptera*, and their parasites. The statements regarding the Atlantic Right whale and Humpback are of interest in the present connection.

Prof. Cope's contributions to American cetology began in 1865, when he established the species *Balæna cisarctica* on the basis of a specimen obtained from

[1] Van Beneden, P.–J., Un Mot sur la Baleine du Japon. *Bull. Acad. R. Belg.* (2), 41, 1875, p. 28.

[2] Van Beneden, P.–J., La Distribution Géographique des Balénoptères. *Bull. Acad. R. Belg.* (2), 45, 1878, pp. 167–178.

[3] *Bull. Acad. R. Belg.* (2), 49, 1880, pp. 313–315.

[4] Van Beneden, P.–J., Sur l'Apparition d'une Petite Gamme de Vraie Baleines sur les Côtes des États Unis d'Amérique. *Bull. Acad. R. Belg.* (3), 9, or 54, 1885, p. 212.

[5] Van Beneden, P.–J., Une Coronule de la Baie de Saint-Laurent. *Bull. Acad. R. Belg.* (3), 20, 1890, pp. 49–54, 1 pl.

the coast of New Jersey. Cope possessed a wider knowledge of the Cetacea than any other American zoölogist and he was very properly looked upon as the foremost exponent of cetology in America. On account of the importance of his work his publications will be given special consideration in a separate chapter. (See pp. 78 *et seq.*).

Reinhardt published in 1868 a supplement to Hallas's article on the Iceland Sulphurbottom, in which he described the skull and some other parts of the skeleton of one of the specimens examined by the latter.[1] He takes up the question of the identity of the Greenland "Tunnolik," and concludes that it is the same species as the Iceland "Steypiredr" and the European Sulphurbottom, usually known as *B. sibbaldii* [= *B. musculus* (L.)].

Dr. J. A. Allen published a catalogue of the mammals of Massachusetts in 1869, in which was included a list of cetaceans, with notes by Capt. N. E. Atwood, and identifications by Cope. Capt. Atwood was a lifelong resident of Provincetown and thoroughly acquainted with matters pertaining to the fisheries, and his comments on the different species are of much importance.[2]

In 1869 the name of Capt. C. M. Scammon first became known to zoölogists, through a remarkable contribution on the Cetaceans of the Western Coast of North America, published under the editorship of Prof. E. D. Cope.[3] This paper was submitted to the Smithsonian Institution, and referred by the then Secretary, Joseph Henry, to Prof. Cope, "with a request to publish such parts as should be deemed valuable to zoölogy, and to add such elucidation and explanation as would contribute to the same end." As published, it really consists of two parts, a systematic paper by Cope and a general natural history essay by Scammon. The correspondence of Scammon indicates that he was not well satisfied with this arrangement, and would rather have named the species himself. At a later date he did name a species, which he discovered in Puget Sound. The proportion of original matter in the article of 1869 is seldom equalled in zoölogical writings. It forms the basis of our knowledge of the cetaceans of the west coast of North America, and, indeed, has been but little added to, except by Scammon himself, either directly or indirectly. Scammon sent many valuable specimens to the Smithsonian Institution, including most of the material mentioned in this article and in his later and larger work, entitled "Marine Mammals of the North-western Coast of North America" (1874). A large part of the natural history matter relating to the Right whales was reprinted by Capt. Scammon in the *Overland Magazine* in 1871, with some slight modifications.[4]

In 1872 Scammon published a diagnosis of a small species of *Balænoptera*

[1] Reinhardt, J., Nogle Bemærkningen om Islændernes "Steypiredr." *Videns. Meddels. naturhist. Foren. Kjöben.*, Aar. 1867, 1868, pp. 178–201.

[2] Allen, J. A., Catalogue of the Mammals of Massachusetts: With a Critical Revision of Species. *Bull. Mus. Comp. Zoöl.*, 1, No. 8, 1869, pp. 202–207.

[3] Scammon, C. M., On the Cetaceans of the Western Coast of North America. *Proc. Acad. Nat. Sci. Phila.*, 1869, pp. 13–63.

[4] Anon., Northern Whaling. *Overland Mag.*, June, 1871, pp. 548–554. Also in an earlier number. This information I have from Prof. Spencer F. Baird.

which he called *B. davidsoni*, from a specimen obtained in Admiralty Inlet, Puget Sound.[1] He afterwards figured this species in his Marine Mammals.

The larger work already mentioned — Scammon's Marine Mammals — appeared in 1874.[2] In this, the matter in the earlier article is repeated with various corrections and amplifications, and an extensive account of the American whale fishery is added. The book is illustrated by figures of various species of whales and porpoises which are among the best found in cetological literature, although not all of them are above criticism in point of accuracy. An appendix to the work was prepared by Mr. Wm. H. Dall, in which the North Pacific species of Cope, Scammon, and other writers are arranged systematically, and elucidated by notes, measurements, etc.

Dr. Moritz Lindeman published in 1869 a very comprehensive work on Arctic fisheries.[3] Among the numerous subjects touched upon are the North Pacific Right-whale and Gray-whale fisheries, the Humpback fishery, etc. Relative to the North Pacific fisheries, Lindeman quoted a long letter from M. E. Pechuel, who accompanied the New Bedford whaler *Massachusetts* to Bering Sea in 1865. This letter contains much valuable information regarding the Right whale of the North Pacific. Lindeman also published a communication from Captain Seabury of New Bedford on the principal whaling stations of the world, containing numerous facts relative to the geographical distribution of the Right whales, Humpbacks, and Gray whales. Coming from persons directly concerned in the whale fishery, these two communications are of special importance. Dr. Lindeman's article as a whole contains an immense amount of valuable information relative to the whale fishery. (See also p. 61.)

The reports of the fisheries branch of the Canadian Department of Marine and Fisheries, beginning with 1870, contain a few notices of the whale fishery in in the Gulf of St. Lawrence, but very little indeed is said about the whales themselves.[4]

Pechuel in 1871 took up the subject of the whale fishery in a series of illustrated articles published in the German periodical, *Das Ausland*.[5] The last article of the series is on the natural history of the whales, and is accompanied by original

[1] SCAMMON, C. M., On a New Species of Balænoptera. *Proc. Calif. Acad. Sci.*, 4, 1873, pp. 269–270. Published in advance, Oct. 4, 1872.

[2] SCAMMON, C. M., The Marine Mammals of the North-western Coast of North America, described and illustrated; together with an account of the American Whale-Fishery. San Francisco, 1874. 4°.

[3] LINDEMAN, M., Die Arktische Fischerei der Deutschen Seestädte, 1620–1868. *Petermann's Geog. Mittheil. Ergänzungsheft*, No. 26, 1869, pp. 1–118, pls. 1–2.

[4] The notices are in the following volumes: *Annual Report Dept. Marine and Fish. Canada for 1870, appendix of Marine Branch*, p. 232; *Report for 1871, appendix, Fisheries Branch*, p. 27; *Report for 1872, appendix, do.*, p. 16; *6th Report for 1873, appendix, do.*, p. 18; *8th Report for 1875, Supplement* 4, *Rept. Comr. Fisheries*, p. 49; *9th Report for 1876, Supplement* 4, *Rept. Comr. Fisheries*, p. 65; *10th Report for 1877, Supplement* 5, *Rept. Comr. Fisheries*, p. 20; *11th Report for 1878, Supplement* 4, *Rept. Comr. Fisheries*, p. 49; *1st Annual Rept. Dept. Fisheries for 1884*, p. 171.

[5] PECHUEL-LOESCHE, M. E., Wale und Walfang. *Das Ausland*, 44, 1871, Nos. 42–50.

figures of specimens of different species examined by the author, measurements, descriptions, etc. These relate chiefly to the species of the North Pacific. The figures of the Right whale and Gray whale are interesting for comparison with those of Scammon, though both are inaccurate to a certain degree.

In 1871 P. Fischer published some brief notes on the Basque whale (*Balæna biscayensis*) in which he refers to *B. cisarctica* and to the whale fishery of the Basques on the Newfoundland banks, which he asserts they reached in 1372.[1]

Fischer's article on Documents relating to the History of the Basque Whale, 1871,[2] contains further references to the Basque whale fishery in the Gulf of St. Lawrence, and other matters concerning Right whales in the North Atlantic.

Prof. A. W. Malm published in 1871 an annotated list of specimens of cetaceans in Swedish museums,[3] in which he mentioned a specimen of a Humpback from Greenland, and one from St. Bartholomew Id., West Indies. The former he places under *Megaptera longimana* and for the latter he accepts the name *M. americana* from Gray, with a query. He gives number of vertebræ, measurements, and other data. The West Indian specimen is especially interesting, as Cope got the type-specimen of his *M. bellicosa* from the same island and the same collector.

Mr. Henry Reeks published a series of articles on the zoölogy of Newfoundland in the *Zoölogist* in 1871, among which is one on cetaceans.[4] An endeavor was made by Dr. Theo. Gill, at Mr. Reeks's request, to connect the common names current in the island for various species with scientific names, but on account of the vagueness of the information furnished this was not particularly successful.

Dr. Thos. Dwight published in 1872 a brief description of a Common Finback [*Balænoptera physalus* (L.)] which stranded at Point Shirley, Boston Harbor, Nov. 25, 1871.[5] He gives measurements, color-description, and other data. In the same year he published a detailed description of the skeleton of a Common Finback captured off Gloucester, Mass., in Oct., 1871. He gives measurements and five figures of the exterior, full descriptions and measurements of the skull, vertebræ and other bones, and numerous figures of different parts of the skeleton, and discusses the relationships of the specimen and its probable specific identity.[6] The paper contains more detailed information and more and better figures than any other paper on *Balænoptera* hitherto published in America.

In 1874 a brief note to the following effect appeared in the Proceedings of the Philadelphia Academy of Sciences:

[1] FISCHER, P., Sur la Baleine des Basques (*Balæna biscayensis*). *Comp. Rend.*, 72, 1871, p. 298.

[2] FISCHER, P., Documents pour servir à l'Histoire de la Baleine des Basques (*Balæna biscayensis*). *Ann. de Sci. nat.*, 1871, Art. 3, pp. 1–20.

[3] MALM, A. W., Hvaldjur i Sveriges Museer, År 1869. *K. Svensk. Vetensk. Akad. Handl.*, 9, No. 2, 1871, pp. 1–104, pls. 1–6.

[4] REEKS, H., Notes on the Zoölogy of Newfoundland. *Zoölogist* (2), 6, 1871, pp. 2550–2553.

[5] DWIGHT, THOS., JR., Description of the Whale (*Balænoptera musculus*) that came ashore in Boston Harbor, Nov. 25, 1871. *Proc. Boston Soc. Nat. Hist.*, 15, pp. 26–27.

[6] DWIGHT, THOS., JR., Description of the Whale (*Balænoptera musculus* Auct.) in the possession of the [Boston] Society [of Natural History]: with remarks on the classification of Fin Whales. *Mem. Boston Soc. Nat. Hist.*, 2, pt. 2, 1872, pp. 203–230, pls. 6–7.

"Prof. Cope mentioned the capture of a young *Balæna cisarctica*, of 48 feet in length, in the Raritan River, near South Amboy, on May 30th. The skeleton was buried and would be preserved in some museum. He examined the whalebone, of which there are 245 laminæ on each side of the mouth. The color is black and the hair is fine, long, and has a brownish tinge; length of longest plate with hair, 48 inches. The gum is 116 inches long and 11 inches deep. He was informed that the whale was entirely black, and the dorsal line without irregularities."[1]

The Greenland Manual, edited by T. Rupert Jones, and published in 1875, contains a revised edition of Dr. Robert Brown's excellent paper on the Cetacea of Greenland.[2] His remarks regarding the Finbacks and Humpback, though brief, are of considerable importance.

Dr. Moritz Lindeman published in 1880 an excellent treatise on sea fisheries,[3] in which he gives a brief account of the whale fisheries carried on in various parts of the world. Especially interesting in the present connection are the statements regarding the Humpback fishery in the West Indies,[4] and the Gray-whale fishery on the coast of California.[5] They may properly be presented here in translation:

"Mr. Archer, who for 14 years fitted out boats for whale fishing, reports as follows regarding the whale fishery about the Barbadoes: 'I find that here the whales have not grown scarcer, and that they are not more shy and more difficult to catch than formerly. . . . Sperm whales are not found here, but are sometimes caught about the Leeward Islands. The baleen of the Humpback is from 3 to 5 feet long. It is to be remarked that this year the carcasses of the whales have begun to be used for manure. The capture of the 'Buckelwal' (*Balæna boops*. English, Humpback) is carried on in the central part of the islands on the lee side, with boats sent out from shore, where the dead fish are drawn out and where the oil is extracted. The Humpback has a length of from 50 to 60 feet, and furnishes 50 to 70 barrels of oil. In the fishing season four boats go out whaling every day, each with 7 men; two boats go toward the North and two toward the South. The whales appear in January, and leave in June; the fishing, however, begins generally in March, as they first appear in larger numbers at this time. The fishing is quite easy if only females with their young appear, more difficult if the males also come in, as the latter keep a good watch.' . . . The females nurse their young in quiet water on the coast and one can, according to Mr. Archer, observe the young nursing very well in clear, but not deep, water.

"Fishing for Humpbacks takes place in the Grenada Ids. in spring and early summer, and 500–800 barrels of oil, worth £1500–2000, are obtained annually.

"At Tobago the whale fishery is carried on by American vessels, with fair results.

"The whale fishery [at Santa Lucia Id.] is carried on by 1 or 2 American

[1] *Proc. Acad. Nat. Sci. Phila.*, 1874, p. 89.

[2] BROWN, ROBT., On the History and Geographical Relations of the Cetacea frequenting Davis Strait and Baffin's Bay. *Manual of Greenland*, T. R. Jones, Editor, 1875, pp. 69–93. Reprinted, with corrections and annotations, from *Proc. Zoöl. Soc. London*, 1868, pp. 533–556.

[3] LINDEMAN, M., Die Seefischereien. *Petermann's Mittheil. Ergänzungsheft*, No. 60, 1880.

[4] *Op. cit.*, pp. 84–86.

[5] *Op. cit.*, pp. 66–67.

schooners principally on the west and south coasts of the island, from March to July."

"On the Californian coast there are about a half dozen whaling stations. From these a constant watch is kept, and if a whale is in sight, row boats go out to fish. These stations are at Punta Banda and at Santo Tomas in Lower California, and in American territory at Ballast Point, at Monterey, at Pigeon Point, and 1 or 2 in Mendocino County. The whales caught on the Californian coast are mostly Gray whales (Graybacks), which are difficult to catch and not very rich in oil; often half of the whales killed are lost. The best fishing is from November to February, at the time when the whales approach the land at the south. From May to October their course is northward somewhat further out at sea."

In 1882 Dr. J. A. Allen published a valuable bibliography of cetology from 1495 to 1840,[1] with critical annotations, and references to the pages on which the names of species and general cetological matter occur. This important guide to cetological literature contains numerous titles of works whose subject-matter is largely or wholly American.

In 1883 Dr. J. B. Holder, of the American Museum of Natural History, published a brief but important memoir on the Atlantic Right whales, containing measurements of four American specimens, descriptions of the skeletons and other data, together with several figures of the exterior, whalebone, skulls, vertebræ, etc. It contains also a summary of literature relating to the Right whales, a synopsis of American and European opinion regarding the various nominal species, and a brief bibliography. Too much space is devoted to matters of little consequence, and too small an amount to the descriptions of the specimens examined. In spite of these defects, its value is unquestionable, especially as it is the only paper on Right whales from the east coast of the United States, with comparative measurements and details, and good illustrations, which has thus far been published.[2] One of the specimens mentioned by Dr. Holder was a skeleton prepared by Dr. G. E. Manigault, curator of the Charleston College Museum, Charleston, S. C. A little later, in 1885, Dr. Manigault gave a fuller description of this specimen in a paper entitled "The Black Whale Captured in Charleston Harbor, January, 1880."[3]

Malm's account of bones of whales collected by the *Vega* Expedition of 1878–80[4] contains numerous woodcuts of portions of skulls of *Rhachianectes* and of other bones of the skeleton of that whale, with detailed descriptions.

In 1884 Dr. G. Brown Goode summed up briefly the more important facts regarding baleen and other whales in American waters, adding some new data.[5]

Flower's list of Cetacea in the British Museum, published in 1885,[6] contains

[1] Allen, J. A., Preliminary List of Works and Papers relating to the Mammalian Orders Cete and Sirenia. *Bull. U. S. Geol. and Geog. Survey of the Territories*, 6, No. 3, 1882, pp. 399–562.

[2] Holder, J. B., The Atlantic Right Whales. *Bull. Amer. Mus. Nat. Hist.*, 1, 1883, pp. 99–137, pls. 10–13.

[3] *Proc. Elliott Soc. of South Carolina*, 1885, pp. 98–104.

[4] Malm, A. W., Skelettdelar af Hval insamlade under Expeditionen med *Vega* 1878–1880. *Bihang, Svensk. Vets. Akad. Handl.*, 8, No. 4, 1883.

[5] Goode, G. B., The Whales and Porpoises. *Fisheries and Fishery Indust. of the U. S.*, Sect. 1, Text, 1884, pp. 7–32.

[6] Flower, W. H., List of the Specimens of Cetacea in the British Museum. 1885.

his views regarding certain species treated of in the present connection. Under the heading of *Balæna australis* he remarks: "Under this name are provisionally included various forms which have been specifically separated either according to locality or from trifling structural peculiarities. Possibly some are distinct, but a more thorough study, with more ample materials than are at present available, will be necessary before their characters can be satisfactorily defined." Under this species he includes specimens from New Zealand, South Africa, Atlantic coast of North America (cast of ear-bones of type of *Balæna cisarctica* Cope), coast of Great Britain, North Pacific, South Seas, and Sandwich Islands. Under *Megaptera boops* he remarks: "It is uncertain whether all the following specimens of *Megaptera* should be referred to one species or to several. If more than one, their distinctive characters have not been as yet clearly defined." The specimens included are from Greenland, California, and New Zealand. Under *Balænoptera rostrata* (= *B. acuto-rostrata*) he includes specimens from Weymouth and the Thames River, England, and from Greenland.

The *American Field* for March 12, 1887, p. 246, contains the following note:

"Several whales were sighted off Amagansett, L. I., March 2, and several crews started in pursuit. A large cow whale was killed the same afternoon. . . . The whale, which is about 60 feet in length, will bring its captors about $1,200 for oil and bone."

Dr. H. Bolau published between 1885 and 1895 three excellent summaries of the natural history and geographical distribution of the larger and more important cetaceans of the Atlantic, Indian, and Pacific Oceans.[1] Though they do not contain much original matter, the best observations are condensed and brought together in a very convenient form, and the charts show careful study and a thorough understanding of the subject and familiarity with the literature. American observations and American species receive a large share of attention.

The *Reports* and *Bulletins* of the United States Fish Commission contain numerous references to whales, many of which, though brief, are of considerable importance. As these references are scattered through a score of volumes, I have thought it desirable to collect them here for convenience. The *Bulletins* contain the following:

[FINBACK WHALE AT GLOUCESTER, MASS.]

"Recently a carcass of a Finback whale 55 feet long drifted ashore on Long Beach, some ten miles from here [Gloucester, Mass.], opposite Milk Island. (July 23, 1880.)"[2]

"Whales are close to the shore. [Gloucester, Mass., May 7, 1882.]"[3]

[1] BOLAU, H., Ueber die wichtigsten Wale des Atlantischen Ozeans und ihre Verbreitung in demselben. *Segelhandbuche für den Atlantischen Ozean, Deutsche Seewarte*, 14 Kap., 1885.

Ibid, Die geographische Verbreitung der wichtigsten Wale des Stillen Ozeans. *Abhandl. Gebiete Naturwis.*, 13, 1895. Also separate.

[2] CLARK, A. HOWARD, Notes on the Fisheries of Gloucester, Mass. *Bull. U. S. Fish Com.*, 4, 1884, p. 407.

[3] MARTIN, S. J. *Bull. U. S. Fish Com.*, 2, 1882, p. 17.

[WHALES AT GLOUCESTER, MASS., 1880.]

"Whales have recently been numerous in this vicinity, and shore boats report many of them swimming about. Four dead ones have been towed into this harbor; the largest was 65 feet long. [Gloucester, Mass., May 13, 1880.]"[1]

[WHALES ON THE NEW ENGLAND COAST, 1886.]

"Whales have been numerous off the New England coast. [June, 1886.] Three steamers are engaged in taking them, being quite successful, although many that are shot and sink in deep water are not recovered."[2]

[WHALE FISHERY IN THE GULF OF MAINE, 1885.]

"Whale fishing off the New England coast by small steamers is getting to be quite a business. During the past two months [March and April (?), 1885] four steamers have been engaged in this work, viz., *Fannie Sprague*, *Mabel Bird*, *Hurricane*, and *Josephine*.

"They cruise off the Maine and Massachusetts shores as far south as Cape Cod. A bomb-lance, fired from a gun held at the shoulder, is used for killing the whales. Up to date about 40 whales have been captured.

"As the men become expert in the manner of capture, the whales become shy and keep more in deep water. After being killed they usually sink, and it is doubtful if the business, as at present conducted, will last if the whales are driven off from near shore, it being difficult to recover them in over 40 fathoms of water.

"The whales captured the past few weeks average 60 feet long and weigh about 25 tons each; they yield about 20 barrels of oil, 2 barrels of meat, 5 tons of dry chum, and two tons of bone, about $400 being realized from each whale, on the average."[3]

[WHALES OFF THE MAINE COAST.]

"The fishermen [at Gloucester, Mass.] say that they have never seen whales so numerous on the eastern shore as at present. The steamer *Fannie Sprague*, of Booth Bay, formerly used in the porgy fishery, which has been fitted out as a whaler, shot six whales last week [March, 1885]. Two of them were safely towed to Booth Bay, but the other four, which sunk, are buoyed. [Gloucester, Mass., March 8, 1885.]"[4]

[STRANDING OF A FINBACK WHALE AT MT. DESERT LIGHT STATION, 1885.]

"Writing under date of July 4, 1885, Thomas Milan, keeper, says: There was a male Finback whale came ashore at this station, July 3. He is 56 feet long, circumference about 25 feet. The flukes have a breadth of 12 feet 1 inch; back fin, 1 foot 3 inches; depth of flukes, 3 feet 2 inches; from snout to back fin, 40 feet; length of mouth, 12 feet. The outside skin was nearly all stripped off, as he had been eaten considerably by the sharks. The color of his back was a dark lead color or nearly black; flukes, upper side, same color; under side, grayish-white."[5]

[1] CLARK, A. HOWARD. *Bull. U. S. Fish Com.*, 4, 1884, p. 404.

[2] WILCOX, W. A., New England Fisheries in June, 1886. *Bull. U. S. Fish Com.*, 6, 1886, p. 201.

[3] WILCOX, W. A., New England Fisheries in April, 1885. *Bull. U. S. Fish Com.*, 5, 1885, p. 169.

[4] MARTIN, S. J. *Bull. U. S. Fish Com.*, 5, 1885, p. 207.

[5] SMILEY, CHARLES W. *Bull. U. S. Fish Com.*, 5, 1885, p. 337.

[WHALES OFF PLYMOUTH, MASS., 1885.]

"Mr. John F. Holmes, keeper of the Gurnet life-saving station [4½ miles N. E. of Plymouth, Mass.], writing under date of July 8, 1885, says that on July 5th schools of whales and porpoises appeared near that station, and on July 7 quite a large quantity of mackerel was taken."[1]

[WHALES ON THE GRAND BANKS, 1885.]

"It is worthy of note that swordfish and Finback whales were seen in unusual abundance on July 13 [between Brown's Bank and N.E. extremity of George's Bank]. During the first part of the day as many as 20 swordfish were seen in from 6 to 8 hours; frequently 2 or 3 were in sight at the same time. As many as 20 whales were seen at one time during the morning, and a still greater number were seen during the afternoon. At station 2528 [lat. 41° 47′ N.; long. 65° 37′ 30″ W.] they were very numerous, apparently feeding on small crustacea, probably from 40 to 50 whales being in sight at one time. They were all Finbacks, so far as I could tell. Their movements were sluggish, as they 'played' back and forth in the tide rips, with their mouths open, the upper jaw just at the surface, scooping in 'feed.' They were joined by a school of porpoises (probably *Delphinus delphis*), which drove in among the whales, their movements indicating that they were feeding, but of this we could not be sure."[2]

[WHALE FISHERY IN THE GULF OF MAINE, 1886.]

"Thus far the 'kyacks' have not been sufficiently abundant to warrant the factory men in devoting their attention exclusively to this species; but the business is carried on profitably in connection with the shore-whaling for Finbacks, which has become important. Last year five small steamers were engaged in this shore-whaling, the fleet landing part of the whales at Provincetown, Mass., and the remainder at the factories in Maine. About seventy-five whales were captured by this fleet last year, and the carcasses of some of them were boiled and made into scrap, which sells when dried at $22 a ton, the only objection to it being the large percentage of oil which it contains. That made to date averages about 25 per cent. of oil." (Extract from a letter of Mr. R. Edward Earll to Prof. S. F. Baird, dated Gloucester, Mass., September 17, 1886.)[3]

In addition, the *Bulletins* contain translations of several important papers on Norwegian whale fisheries, and an article by Mr. Chas. H. Townsend on the California Gray whale, *Rhachianectes glaucus*.[4] This article specifies the number and location of the whaling stations on the California coast, the number of whales taken, their habits, food, etc., and is accompanied by four original drawings of a fœtal specimen 17 ft. long observed at St. Simeon Bay, Cal.

The *Reports* of the Commission contain the following:

[1] SMILEY, CHARLES W. *Bull. U. S. Fish Com.*, 5, 1885, p. 347.

[2] COLLINS, J. W., Notes on an investigation of the Great Fishing Banks of the Western Atlantic. *Bull. U. S. Fish Com.*, 6, 1886, p. 381.

[3] *Bull. U. S. Fish Com.*, 6, 1886, pp. 312–313.

[4] TOWNSEND, C. H., Present Condition of the California Gray-whale Fishery. *Bull. U. S. Fish Com.*, 6, 1886, pp. 346–350, pls. 6–7.

[WHALES OBSERVED ABOUT NEWFOUNDLAND AND IN THE GULF OF ST. LAWRENCE, 1887–8.]

"On July 16 eight Humpback whales were seen; two of them to the southwest of Cape Pine [Newfoundland]; two between Cape Pine and Cape Race, and four others to the northeast of the latter point. Several whales were seen off Canada Head [Newfoundland] on July 29. A small Finback came into the harbor near the vessel on several occasions while we lay in Canada Bay [Newfoundland], usually making its appearance near sunset. North of Groais Island and Cape Rouge [Newfoundland], on August 3, and between that point and Cape Bauld, Humpback and Finback whales were seen in abundance. During the afternoon of August 10, while off Mingan [Quebec], a number of whales were seen; their appearance being particularly noticeable on account of their closeness inshore. A Pike whale (*Balænoptera?*) was feeding near the vessel in Mingan Harbor on August 14. An attempt was made to capture it; a bomb-lance was fired at it, but going wide of its mark only frightened the animal so that it soon left the harbor."[1]

[WHALES OFF SANTA BARBARA CO., CAL.]

"Whales, chiefly the California Gray, are reported to be numerous off the coast of this county during the winter, when they frequently come close inshore. In summer they migrate northward. None have been captured, however, in recent years, but quite an important shore whale fishery could be prosecuted, as in former years, if the price of oil should advance sufficiently to make the business remunerative. The profits might now be materially enhanced by the utilization of the carcasses for the manufacture of fertilizer—a product that ought to find a ready sale at good prices."[2]

[WHALES OFF THE COAST OF SAN LUIS OBISPO CO., CAL.]

"Whales appear chiefly in fall and winter, as on other parts of the coast south of San Francisco. Four species, the Humpback, California Gray, Finback, and Sulphurbottom, are said to occur, but only Gray whales were taken in 1888. These are about 35 to 40 feet in length, and yield about 25 or 30 barrels of oil."[3]

"*The shore whale fishery.*—San Simeon Bay and vicinity and about 'Whalers' Point,' near Port Harford, have been considered the best grounds in this county for whaling. Whales are said to be scarcer than formerly along this section of the coast. It is believed by some of the old fishermen that this scarcity is to some extent due to the presence of steamers on the coast.

"From 1869 to 1887 a shore whaling station was maintained at Whalers' Point, where, it is said, as many as 30 or 40 whales were taken in the most prosperous seasons. But in 1887, the last year of the fishery at this place, only 5 whales were captured. The scarcity of whales, together with the low price of oil, contributed to the abandonment of the station. The whaling company here consisted of 20 men, who operated 3 boats manned by 6 men each. In 1880 there were 21 men.

"A whaling station was established at San Simeon Bay in 1865 by a man who had formerly engaged in this fishery at Monterey, San Diego, and Portuguese Bend.

[1] COLLINS, J. W. and D. E., Report on the Operations of the Fish Com. Schooner *Grampus*, 1887–8. *Rept. U. S. Fish Com.*, 15, 1891, pp. 525–526.

[2] COLLINS, J. W., Report on Fisheries of Pacific Coast. *Rept. U. S. Fish Com.*, 16, 1892, p. 45.

[3] *Op. cit.*, p. 50.

The business has been continued, with, perhaps, temporary intermissions, until the present time. Between 20 and 30 whales have often been taken in a season, and an average of 17 for the first 16 years. This station, as well as the other shore whaling stations along the coast, was reported as closed during the early part of 1888, but was reopened in the fall, and up to March 9, 1889 (at which time the fishery was suspended), 14 whales had been taken, which yielded 440 barrels of oil, valued at $5,720. . . .

"The season is from November to the middle of March, after which date the whales have generally left the coast on their annual migration north. The species taken here is usually the Gray whale; the Humpback or 'summer whale' is rarely captured, and the same may be said of the Right whale. The best success is usually met with in the early part of the season, when the whales are going south, for in the late winter and spring, when returning, they keep farther off shore, and the prevailing northerly winds and rough sea often prevent their successful pursuit. Besides, as they are then in poor condition, there is not the same inducement to hunt them. . . .

"Alexander states that 'December, January, and February are the months in which whales frequent this locality; sometimes, however, a few are seen as late as the middle of March. These months are called the down-run season; the up-run is of short duration, which, as a rule, lasts from 4 to 6 weeks. Whales when migrating north are poor, but on their return south are invariably fat and contain about 50 per cent more oil than when on their northern passage.'"[1]

[WHALES OFF THE COAST OF MONTEREY CO., CAL.]

"Whales are reported more numerous than they were a few years ago, but no attempt has been made to take them at Monterey Bay since 1881, and the shore whaling station at Carmel Bay was closed three years later."[2]

[WHALES OFF CAPE FLATTERY, WASHINGTON.]

"Whales, chiefly the small sharp-headed finner (*Balænoptera davidsoni* Scammon), are found off Cape Flattery and at the entrance of the Strait of Juan de Fuca, where the Indians improve every opportunity to capture them."[3]

[WHALES OFF THE QUILLIHUTE R., WASHINGTON.]

"These [Quillihute] Indians also engage in whaling during the summer; nine Finback whales were captured in 1888; these were cut up and smoked for food. The catch is wholly for home consumption and has no commercial importance."[4]

[WHALES OFF THE COAST OF CALIFORNIA, MARCH AND APRIL, 1890.]

"Whales were very common and were reported nearly every day, sometimes in large numbers. On one occasion we steamed slowly into a school that were so busily engaged in feeding that they paid little attention to us. Upon investigation it was ascertained that they were devouring a small globular jellyfish, half an inch in diameter, which could be seen in immense masses from 3 to 5 fathoms

[1] COLLINS, J. W., Report on Fisheries of Pacific Coast. *Rept. U. S. Fish. Com.*, 16, 1892, pp. 52–53, pl. 3. [2] *Op. cit.*, p. 58. [3] *Op. cit.*, p. 245. [4] *Op. cit.*, p. 243.

beneath the surface. Thousands of sea birds were hovering over or around the busy scene."[1]

[FINBACKS AT UNALASKA.]

"There was a large school of Finback whales feeding in Broad Bay, during the day [August 21, 1890], which paid but little attention to us, simply moving out of the way or diving under the ship when we approached them. On one occasion the same school was seen playing around a whaler, but no attention was paid to them. Nothing but merchantable bone will tempt the modern whaleman. We returned to port the same evening."[2]

[SAN SIMEON BAY WHALING STATION, CALIFORNIA.]

"Seven whales were taken during each of the seasons 1888 and 1889. Those obtained in 1888 yielded 180 barrels of oil, while 260 barrels were taken from the catch of 1889. This difference was due to the larger size of the whales in the latter year. Whales frequent this region during the months of December, January, and February, but in some years a few are seen as late as the middle of March. It is during these months that the 'down run' takes place. The 'up run' is of shorter duration, lasting as a rule from four to six weeks. While moving south the whales are invariably fat, containing 50 per cent. more oil than on the return north. Twenty-one men and nine boats are employed at this station during the whaling season. Only two men are retained in the summer, to look after the boats and buildings. The crew receives a lay of one-fiftieh, the harpooner or shooter (the harpoon being fired from a gun) one-sixteenth."[3]

2. *Records of the Colonial Shore Whale-fishery.*

The available records of this fishery, which had for its object the capture of the Right whale, *Balæna glacialis*, are scattered through the publications of the historical societies of the several States, the published official archives, and various State and town histories. The items contained in these records are chiefly of an industrial nature, but among them are many bits of natural history. To pick these out from the great mass of other material is a time-consuming operation, but may on the whole be considered as repaying the effort required. A part of this matter has been referred to, or mentioned, in Starbuck's History of the American Whale Fishery,[4] and again in Clark's History of the American Whale Fishery,[5] but both these works are concerned primarily with industrial matters, and only incidentally touch upon the natural history of the whales. The following items from Starbuck's history are of interest in the present connection as indicating the seasons in which whales were captured, etc.:

[1] TANNER, Z. L., Report on Investigations of the U. S. Fish Com. Steamer *Albatross*, 1889–91. *Rept. U. S. Fish Com.*, 17, 1893, p. 226.

[2] *Op. cit.*, p. 245.

[3] *Op. cit.*, p. 279.

[4] STARBUCK, ALEX., History of the American Whale Fishery, from its earliest inception to the year 1876. *Rept. U. S. Fish Com.*, part 4, 1878; Appendix A, pp. 1–768, pls. 1–6.

[5] CLARK, A. HOWARD, History and Present Condition of the Fishery. *Fisheries and Fishery Indust. of the U. S.*, Sect. 5, vol. 2, 1887, 3–218.

"In April (4th), 1656, the council of New York 'received a request of Hans Jongh, soldier and tanner, asking for a ton of train-oil, or some fat of the whale lately captured.'"[1]

"Francis Nicholson, writing from Fort James, December, 1688, says—'Our whalers have had pretty good luck, killing about Graves End [Long Island] three large whales. On the Easte End aboute five or six small ones.'"[2]

"In 1708, under Lord Cornbury, an act was passed for the 'Encouragement of Whaling' [at Long Island], in which it was provided, 1st, that any Indian, who was bound to go to sea whale-fishing, should not 'at any time or times between the First Day of November and the Fifteenth Day of April following, yearly, be sued,'" etc.[3]

"'In 1719, February 24, a [Long Island] whaleboat being alone, the men struck a whale, and she, coming up under ye boat, in part staved it.'"[4]

"Under date of March 20, 1727, the Boston *News-Letter* says: 'We hear from the Towns on the Cape [Cod] that the Whale Fishery among them has failed much this winter, as it has done for several Winters past, but having found out the way of going to Sea Upon that Business, and having had much Success in it, they are now fitting out several Vessels to sail with all Expedition upon that dangerous Design this Spring, more (its tho't) than have ever been out from among them.'"[5]

"The same paper in its issue of February 12, 1730, contains the following extract from a letter from Chatham [Mass.], dated 'February 6, 1729–30': 'There has been a remarkable Providence in the awful death of some of my neighbors; on the day commonly called New Year's Day, a whaleboat's Crew coming home from a Place called Hog's-Back, where they had been on a Whaling design, the Boat was overset, and all the Men lost, on a reaf of Sand that lies out against Billingsgate.'"[6]

"In March, 1736, the inhabitants of Provincetown captured a large whale at sea, cut him up, and brought the blubber into that port. The estimated quantity of oil that this blubber would produce was 100 barrels."[7]

"The season of 1737–8 must have been an unfortunate one at Provincetown [Mass.], for up to January 5, 1738, the people of that town had only killed two small whales, and some of the inhabitants took into serious consideration a change of residence. In July, 1738, Captain Anthony Hough, master of a whaling vessel, took 'in the Straits' [of Belle Isle] a large whale, and brought him to the vessel's side to cut in. . . . In February, 1738, the Yarmouth [Mass.] whalemen had killed but one large whale during the season; the bone of that one was from 8 to 9 feet long. Nor was the whaling-season of 1738–9 any more successful to the inhabitants of the Cape [Cod]. Up to the 15th of February, 1739—the whaling-season being then over—there had been taken at Provincetown [Mass.] but six small and one large whale, and at Sandwich [Mass.] two more small ones."[8]

"In August, 1723, a drift-whale is advertised in the Boston *News-Letter* as ashore at Marblehead [Mass.]"[9]

"The Boston papers of December 12, 1707, state that a whale 40 feet long entered that harbor and several whale-boats pursued and killed her near the back of Noddle's Island."[10]

"We find in the *News-Letter* of September 3, 1722, an advertisement of a

[1] STARBUCK, p. 11. From *N. Y. Coll. MSS.*, 6, p. 354.
[2] *Ibid.*, p. 15. From *Mass. Coll. MSS.*, 6, p. 303.
[3] *Ibid.*, p. 25. From Bradford's Laws of New York, p. 72.
[4] *Ibid.*, p. 30. From Hedges in *N. Y. Col. Rec.*, 5, p. 579.
[5] *Ibid.*, p. 31.
[6] *Ibid.*, pp. 31–32.
[7] *Ibid.*, p. 32.
[8] *Ibid.*, pp. 32–33.
[9] *Ibid.*, p. 34.
[10] *Ibid.*, p. 34.

court of admiralty to be held to adjudicate on a drift-whale found floating near Brewster's [Mass.], and towed ashore in August."[1]

"By the inhabitants of Martha's Vineyard, in 1702–3, there appear to have been several whales killed. The following entry occurs under that date in the court records: 'The marks of the [3] whales killed by John Butler and Thomas Lathrop. . . . These whales were all killed about the middle of February last past; all great whales, betwixt six and seven and eight foot bone, which are all gone from us.'"[2]

"In the *News-Letter* [Boston] of August 8, 1765, is the following statement: 'Tuesday one of the sloops which has been on the Whaling Business returned here. We hear that the vessels employed in the Whale Fishery from this and the neighboring Maritime Towns, amounting to near 100 Sail, have been very successful this Season in the Gulph of St. Lawrence and Streights of Belle isle; having, 'tis said, already made upwards of 9,000 Barrels of Oil.'"[3]

On p. 47, Starbuck quotes the proclamation of Gov. Hugh Palliser, dated August 1, 1766, a part of which is as follows:

"Whereas great Numbers of the Whaling Crews arriving from the Plantations on the Coast of Labradore early in the Spring considering it as a lawless Country are guilty of all Sorts of Outrages before the arrival of the King's Ships. . . . For preventing these Practices in future Notice is hereby given That the King's Officers stationed in those Parts, are authorized and strictly directed, to apprehend all such Offenders within this Government. . . . This Notification is to be put in the Harbours in Labradore, within my Government, and through the Favour of His Excellency Governour Bernard, Copies thereof will be put up in the Ports within the Province of Massachusetts, where the Whalers mostly belong, for their Information before the next Fishing Season."

On p. 49, the following remarks are made:

"It was currently reported in the colonies, during the early part of 1767, that the irksome restrictions upon whaling were to be entirely removed; petitions to that effect had been presented to the home government, and a favorable result was hoped for, and early in 1768 the straits of Davis and Belle Isle were again vexed by the keels of our [American] fishermen, as many as 50 or 60 anchoring in Canso Harbor in April of that year, a few of them bound for the former locality, but the majority of them cruising in the vicinity of the Gulf of St. Lawrence and Newfoundland. (From a log-book kept by Isaiah Eldredge, of the Sloop *Tyrall*, of Dartmouth, which sailed April 25, 1768, for the straits of Belle Isle. She cleared from Nantucket, as Dartmouth was not then a port of entry. On Friday, April 29, she was at anchor in Canso Harbor; with 50 or 60 other whalemen. Saturday, May 7, left Crow Harbor and at night anchored in Man-of-War Cove, Canso Gut, 'with about 60 sail of wailmen.' The vessels were continually beset with ice and on the 23d of May they cleared their decks of snow, which was 'almost over shoes deep.' They killed their first whale on the 22d of July. The larger number of vessels were spoken in pairs, which was the usual manner of cruising. The sloop returned to Dartmouth on the 5th of November)."

[1] STARBUCK, p. 35. [2] *Ibid.*, pp. 35–36. [3] *Ibid.*, pp. 44–45.

In his list of whaling vessels under date of 1789, Starbuck notes that 8 vessels sailed from Cape Cod for the Strait of Belle Isle. One of these arrived in the home port October 6th, two others also in that month, and one in August.[1]

In the Collections of the Massachusetts Historical Society are various other references to the whale fishery, but very little regarding the whales themselves. The following are the most important:

In an address to King James II. by the Colony of New Plymouth, signed by Thos. Hinckley, October, 1687, we find this note:

"There are also some small whales, or part of them, sometimes in some winters cast on our shore—some whereof making, with much labor, seven or eight barrels of oil, and some between that and twenty,—which have been some help to the poor of those poor towns planted on the Cape, being the barrenest part of the country."[2]

A letter of Saml. Maverick to Sampson Bond (in the Winthrop papers), dated from New York, May 30, 1669, states of New England:

"Coddfish is found in abundance on this coast; above 20 whales gotten this Spring."[3]

The Winthrop papers also contain a letter from Wait Winthrop to Fitz-John Winthrop, dated January 27, 1700, as follows:

"The winter has bin so favorable that they have killed many whales in Cape Cod bay; all the boates round the bay killed twenty nine whales in one day, as som that came this week report; as I came by when I was there last one company had killed thre [3], two of which lay on Sandwich beach, which they kild the day before, and reckned they had kild another the same day, which they expected would drive on shore in the bay."[4]

In 1749 was published a work entitled "A Summary Historical and Political of the British Settlements in North America," by Wm. Douglass,[5] in which the author inserts two "digressions" concerning whales and the whale fishery. Though covering but a few pages and repeating one another to a considerable extent, they contain valuable data regarding the whales of the Atlantic Coast, and especially the Right whale. The matters touched upon are the number of kinds of whales recognized by New England whalers, the characters of the Greenland Right whale, New England Right whale, Finback, Humpback, and "Scrag" whales; the migrations and habits of different species; changes in habits due to excessive fishing and differences in temperature in different winters; fishing stations; and kind of

[1] STARBUCK, p. 187.

[2] *Mass. Hist. Coll.* (4), 51, p. 78

[3] *Ibid.*(4), 7, p. 318.

[4] *Ibid.* (6), 5, p. 55.

[5] DOUGLASS, WM., A Summary, Historical and Political . . . of the British Settlements in North America. 2 vols. London, 1749–53. 8°. Published again in 1760.

This work was originally published in 1747 in smaller form and much briefer. There was no cetological matter in the imperfect copy which I examined in the Library of Congress. Allen states that there appears to have been another edition in 1755.

whales captured about Bermuda.[1] A number of the natural history observations appear to have been taken from Dudley, and paraphrased and much condensed, but the major part of the matter is original.

Young's Chronicles of the Pilgrim Fathers, published in 1841,[2] contains an interesting note by the author relative to whales occurring about Cape Cod, Mass., which has already been quoted on p. 22, foot-note.

The second edition of Felt's Annals of Salem, Mass., published in 1849,[3] has several pages devoted to statements regarding the American whale fishery (including a number of natural history notes) arranged chronologically. The following are the most important:

Mch. 12, 1692. John Higginson and Timothy Lindall write to Nathaniel Thomas complaining that the whales were taken away from them, as follows:

"Ye first was when Woodbury and company, in our boates, in the winter of 1690, killed a large whale in Cape Cod harbour. . . . The second case is this last winter, 1691. William Edds and company, in one of our boates, struck a whale, which came ashore dead, and by ye evidence of the people of Cape Cod, was the very whale they killed." (2, pp. 223, 4.)

"1765, Aug.—The whale fishery from Boston and the neighboring ports amounts to 100 sail, which have been successful this season in the Gulf of St. Lawrence and Straits of Belle Isle, having taken upwards of 9,000 barrels of oil." (2, p. 225.)[4]

Winsor's History of Duxbury, Mass., has a few notes on the colonial whale fishery at that place,[5] as follows:

"1690. John Wadsworth was appointed to view whales, that may be cast ashore in the town."

"1712. Marshfield, Nov. 28: On Tuesday, the 25th current, six men going off the Gurnet Beach in a whale boat at Duxbury after a whale . . . were all drowned."

"1724. Dec. 3d. A whale captured off the beach."

"1770. A dead whale was found a quarter of a mile from the beach. . . . The whale washed ashore and made 15 barrels.

Freeman's History of Cape Cod, 1858,[6] contains a letter from Wm. Clapp to Squire Dudley, dated Cape Cod, July 13, 1705, which states:

"I have very often every year seen that Her Majesty has been very much wronged of her dues by these country people and other whalemen as come here awhaling every year which take up drift whales which were never killed by any man," etc.

[1] *Op. cit.*, 1, pp. 56–60 and 296–298.

[2] YOUNG, ALEX., Chronicles of the Pilgrim Fathers, 1602–25. Boston, 1841.

[3] FELT, J. B., Annals of Salem, 2d ed., 1849, 2, pp. 223–226. I have not seen the 1st edition.

[4] The following note also occurs:

"1808. Off the Brimbles, a whale sixty feet long, is found dead by some men from Marblehead." (*Op. cit.*, 2, p. 94.)

[5] WINSOR, J., History of Duxbury, 1849, p. 86.

[6] Vol. 1, p. 342. Spelling corrected.

A history of New London, Connecticut, written by Frances M. Caulkins, the first edition of which appeared in 1852, has a chapter devoted to the whale fishery from that port.[1] It treats chiefly of the period subsequent to the Revolution, and gives names of vessels, number of barrels of oil obtained, the grounds visited, and other details. In a foot-note to page 638 of the edition of 1895 is the following:

"The following memorandum implies that such whaling trips [in boats] were not unusual: January 13th, 1717–18. 'Comfort Davis hath hired my whaleboat to go awhaling to Fisher's Island, till the 20th of next month, to pay twenty shillings for her hire, and if he stays longer, thirty shillings. If she be lost, and they get nothing, he is to pay me £3, but if they get a fish, £3-10*s*.'" [Hempstead.]

On page 639, is another important note, as follows:

"We have no statistics to show that the whale fishery was ever carried on except in this small way, from any part of the Connecticut coast, before the Revolutionary War.—Foot-note: In June, 1850, a whale 35 feet long, was captured in Peconic Bay, near Greenport."

The records of the New London County Historical Society contain an article by C. A. Williams on whaling at New London. This is an important essay, beginning with a brief chronological history of the whale fishery, especially from 1718 onward; then follows an account of the conditions under which the New London fishery was conducted, the methods employed, the regions visited, etc.; then a journal of Capt. James Davis of the ship *Chelsea* in a whaling voyage to the Pacific in 1831; incidents and accidents of the fishery; number of vessels employed, profits, etc. The article has as an appendix a letter from Wm. H. Allen to C. A. Williams, containing miscellaneous information relative to whales and whaling, kinds of whales pursued, size, yield of oil, whalebone, etc.[2]

O'Callaghan's Documents relating to the Colonial History of the State of New York, 14 volumes, contain a large number of important records regarding the whale fishery which was carried on on the south coast of Long Island for a century, beginning about 1652. These consist chiefly of licenses to carry on the fishery, orders of the court in disputes concerning "drift whales," the employment of Indians in the fishery, etc., but there are also many references to the number and size of whales captured, the seasons for whaling, and other matters of interest in the present connection. The following are among the more important:

A letter from Samuel Maverick to Colonel Nicholls, dated from New York, July 5, 1669, contains the following:

". . . On ye East end of Long Island there was 12 or 13 whales taken before ye end of March, and what since wee heare not; here are dayly some seen in the very harbour, sometimes within Nutt Island. Out of the Pinnace the other

[1] CAULKINS, FRANCES M., History of New London, Connecticut, from 1612 to 1860, 1895, pp. 638–647.

[2] WILLIAMS, C. A., Early Whaling Industry of New London. *Records and Papers of the New London County Hist. Soc.*, pt. 1, vol. 2, 1895, pp. 3–22.

week they struck two, but lost both, the iron broke in one, the other broke the warpe. The Governour hath encouraged some to follow this designe. Two shallops made for itt, but as yett wee doe not heare of any they have gotten."[1]

In a letter from Lord Cornbury to the Lords of Trade, dated July 1, 1708, is the following:

". . . The quantity of Train Oyl made in Long Island is uncertain. Some years they have much more fish than others, for example last year they made four thousand Barrils of Oyl, and this last Season they have not made above Six hundred; About the middle of October they begin to look out for fish, the Season lasts all November, December, January, February and part of March; a Yearling will make about forty Barrils of Oyl, a Stunt or Whale of two years old will make sometimes fifty, sometimes Sixty Barrils of Oyl, and the largest whale that I have heard of in these Parts, Yielded one hundred and ten barrils of Oyl, and twelve hundred Weight of bone."[2]

In a warrant signed May 10, 1672, is the following item:

"Whereas I am given to understand that a Whale hath not long since been cast upon a parcell of Beach claymed to bee wth in *Jno Coopers* Bounds or Precincts, of the wch severall Indians have taken & carried away the Whale-Bone; These are to authorize the said *Jno Cooper* to make Enquiry into and to make seizure of such Whale-Bone."[3]

An order signed by Governor Andros, in November, 1675, reads thus:

"Vpon the Petiçon and Desire of *Jacob Schellinger* and Company of *East-Hampton*, who are joyntly concerned in carrying on a Designe of Whale Killing at the said Place . . . I doe hereby give them Liberty to employ the said foure Indyans for this present whale ffishing season. Given under my hand in *New Yorke* this 18th day of November 1675. E. Andros."[4]

The petition which called forth this order several times alludes to "this whale season soe nigh at hand."[5]

Thompson's History of Long Island, New York, published originally in 1839, contains some notes on the colonial shore fishery for Right whales at Sag Harbor and Southampton,[6] and also the following:

"Easthampton, Aprill 2^{d}, 1668. Know all men by these presents, y^{t} wee whose names are signed hereunto, being Indians of Montauket, do engage ourselves in a bond of ten pounds sterling for to goe to sea uppon ye account of killing of whales, this next ensuing season, beginning at the 1st day of November next, ending by ye first of Aprill ensuing; and that for ye proper account of Jacobus Skallenger and his partners of Easthampton; and engage to attend dilligently with all opportunitie for ye killing of whales or other fish, for ye sum of three shillings a day for every Indian; ye sayd Jacobus Skallenger and partners to furnish all necessarie craft and tackling convenient for ye designe."

[1] O'Callaghan, E. B., Documents relating to the Colonial History of the State of New York, 3, p. 183. The index to these volumes is in vol. 11.
[2] *Op. cit.*, 5, p. 59.
[3] *Op. cit.*, 14, p. 665.
[4] *Op. cit.*, 14, p. 707.
[5] *Op. cit.*, 14, pp. 708–709.
[6] Thompson, Benj. F., History of Long Island, New York, 1st ed., 1839, pp. 221–224.

"Agreement made the 4th of January, 1669, between ye whale companies of East and Southampton. If any companie shall finde a dead whale uppon the shore, killed by ye other, a person shall bee immediately sent to give notice; and the person bringing the news to bee well rewarded. And if one companie shall finde any whale so killed at sea, they shall endeavor to secure them, and have one half for their pains, and any irons found in them to bee returned to ye owners."[1]

In the second edition of this work, published in 1843,[2] is the following:

"As an evidence of the extent to which boat-whaling was carried, on this part of Long Island [Brookhaven], at the beginning of the eighteenth century, we present the following items from a manuscript in the handwriting of Madam Martha, widow of Col. Wm Smith of St. George's Manor:

"'Jan. ye 16, 1707 (she says) my company killed a yearling whale, made 27 barrels. Feb. ye 4, Indian Harry, with his boat, struck a stunt whale and could not kill it — called for my boat to help him. I had but a third, which was 4 barrels. Feb. 22, my two boats, and my son's, and Floyd's boats, killed a yearling whale, of which I had half—made 36, my share 18 barrels. Feb. 24, my company killed a school whale, which made 35 barrels. March 13, my company killed a small yearling, made 30 barrels. March 17, my company killed two yearlings in one day; one made 27, the other 14 barrels.'

"The following is the receipt for duties: 'New York, this 5th June, 1707, then received of Nathan Simson, ye sume of fifteen pounds, fifteen shillings, for acct of made Martha Smith, it being ye 20th part of her eyle, by virtue of a warrant from my Ld. Cornbury, dated 25th of March, last past, 1707. Per me, Elias Boudinot.'"

Hubbard's General History of New England contains the following:

"The next place, on that called Long Island, is East Hampton, at the furthest end eastward; then South Hampton; next, Southhold, where the inhabitants of late [1635–1650?] have fallen upon the killing of whales, that frequent the south side of the island in the latter part of the winter, wherein they have a notable kind of dexterity; and the trade that ariseth therefrom hath been very beneficial to all that end of the island."[3]

"Upon the south side of Long Island, in the winter, lie store of whales and grampuses, *which* the inhabitants begin [1635–1650?] with small boats to make a trade of catching, to their no small *benefit*."[4]

It is by no means certain that the expression "of late" refers to the period 1635–1650, the events of which were being chronicled. More probably it refers to the date at which the history was written. Shore whaling appears to have been begun on Long Island about 1652.

Weeden's Economic and Social History of New England, 1890, contains a chapter on colonial whale fishery, in which some of the foregoing notices of whales and whaling seasons are quoted or referred to, together with many relating to the fishery itself.[5]

[1] Thompson, Benj. F., History of Long Island, New York, 1st ed., 1839, p. 191.

[2] Vol. 1, p. 438, foot-note. [3] P. 668. [4] P. 673.

[5] Weeden, Wm. B., Economic and Social History of New England, 1620–1789, 2 vols., Boston, 1890.

The Records of the town of East Hampton, Long Island, published in 1887 (4 vols.) contain many references to whales and all in winter.

Notices of the shore whale fishing on the coast of New Jersey and in Delaware Bay are contained in the published archives of the State of New Jersey, in the collections of the New Jersey Historical Society, in Hazard's Annals of Pennsylvania, in Acrelius's History of New Sweden, and other works, but such of them as I have examined contain no information regarding the whales or the seasons at which they frequented these waters.[1]

The accounts of the establishment of a whale fishery in Delaware Bay given by De Vries and Van der Donck have been already quoted in the previous chapter (p. 24).

Watson's Annals of Philadelphia contains a number of items relative to whales and whaling in Delaware Bay and River and along the coast of New Jersey, dating from 1683 to 1834, but they are hardly definite enough to be of much value. The work was originally published in 1830, but the following quotations, which include all the items of any importance, are from the revised edition of 1898.[2]

"In 1730, a cow whale, of 50 feet length is advertised as going ashore to the northward of Cape May, dead. The harpooners are requested to go and claim it."

"In 1733, month of April, 2 whales, supposed to be cow and calf, appeared in the [Delaware] river before the city."

"In 1736, February, 'two whales are killed at Cape May, equal to forty barrels of oil, and several more are expected to be killed by the whalemen on the coast.'"

"About the year 1809 . . . a whale of pretty large dimensions was caught near Chester."

"Two dead whales were driven on shore at Assateague beach, near Snowhill, Maryland, in December, 1833; one a hundred and seventeen feet in length, and the other eighty-seven feet in length."

"It is a fact but little known, that, even now [1823?], there is a family on Long beach, New Jersey, who are every winter seeking for, and sometimes capturing whales. In this business they have been engaged, the father and two sons, ever since the time of the Revolution."

"In May, 1834, a young whale, of sixty feet, went into New Haven [N. J.?] harbour—was chased, grounded, and used up."

The American whale fishery was the topic of an elaborate article published by James H. Lanman in 1840.[3]

[1] See HAZARD, S., Annals of Pennsylvania, 1609–1682, 1850, pp. 31–32.

Instructions to John Printz, Governor of New Sweden, August 15, 1642. In Acrelius's History of New Sweden, *Mem. Penn. Hist. Soc.*, 11, 1874, p. 38.

THOMAS, GABRIEL, Historical Description of the Province and Country of West-New-Jersey, 1698, p. 33.

WHITEHEAD, W. A., East Jersey under the Proprietary Governments, *Coll. N. J. Hist. Soc.*, 1, p. 174.

Scot's Model of the Government of the Province of East-New-Jersey, 1685, *op. cit.*, p. 282.

Documents relating to the Revolutionary History of New Jersey, 1, 1901, p. 437.

[2] WATSON, JOHN F., Annals of Philadelphia and Pennsylvania, enlarged by Willis P. Hazard, 3 vols., 1898. Vol. 2, pp. 428–429; 547.

[3] Hunt's *Merchants' Magazine*, 3, 1840, pp. 361–394.

It is entirely a compilation and deals principally with the industrial aspects of the fishery. The only paragraphs (pp. 376 and 380) which refer to the natural history of the baleen whales contain nothing of importance.

The remark of Lawson in his Natural History of North Carolina regarding the absence of a regular whale fishery in these waters is apparently borne out by the colonial records and histories. Those which I have examined, such as Saunder's Colonial Records of North Carolina, Hawkes's History of North Carolina, and others, contain no mention of the matter. The same is true of South Carolina. Such works as Drayton's View of South Carolina, Mills's Statistics of South Carolina, Ramsay's History of South Carolina, etc., offer no information regarding whales or the whale fishery.

CHAPTER III.

A REVIEW OF COPE'S AND SCAMMON'S SPECIES.

In the history of American cetology two names will always stand out with special prominence, — those of Professor E. D. Cope and Captain C. M. Scammon. Cope's observations on existing *Balænidæ* cover a period extending from 1865 to 1891. During this time he described as new four species and one genus from the east coast of the United States, one species from the West Indies, and four species and one genus from the west coast of North America. In the present chapter I propose to give a list of these various species, to indicate the nature and condition of the material on which they are based, and to state the present whereabouts of the types. The original descriptions and measurements will be given in some cases and in others a summary of differential characters. The west coast species will be given further consideration in a separate chapter.

Scammon described but a single species, *Balænoptera davidsoni*, although, as already seen, he furnished the information and material on which Cope's various west coast species were based.

Cope in his first essays gave scientific names to such stranded specimens of Atlantic whales as accidentally came under his observation. His intention was not to found species additional to those of which specimens are commonly captured or cast up on our shores, but to give these a place in zoölogical nomenclature. Thus he speaks of his *Balæna cisarctica* as "the Black whale of the whalers of our coast," etc. That these several species received new names was because he thought they were distinguishable from the species frequenting the coasts of Europe, and not because they were rare American forms unknown to whalers and others whose business was with the sea. The same is largely true of the Pacific species. Cope's *Megaptera versabilis* was "The North Pacific hump-back." His *Balænoptera velifera* was "The Finner Whale of the Oregon coasts," his *Sibbaldius sulfureus* was "The Sulphur-Bottom of the North-West Coast." On account of this circumstance I have not thought it necessary to present extended arguments to prove that the types of Cope's species were the same specifically as specimens from our coast which have accumulated since the former were described, except in cases in which, from an examination of the types, I have found that the species were not properly characterized at the start. In the subsequent chapters the types will be examined along with other specimens. It is obvious that if they do present special characters, these will make themselves noticeable.

Genus BALÆNA Linnæus.

1. Balæna cisarctica Cope. 1865.

"The Black Whale of the Whalers of our Coast."

Original description: Proceedings, Academy of Natural Sciences, Phila., 1865, No. 3, July–Aug., pp. 168–169. Read Aug. 8, 1865.

Type-locality and date: Opposite Philadelphia, on the coast of New Jersey, 1862.[1]

Type-specimen: Nearly complete skeleton of a half-grown individual, presented to the Philadelphia Academy by George Davidson. The whale had previously been exhibited for some time.

Cope estimated that the length of the skeleton if complete would be 37 feet. It lacks the right nasal bone, the malars, the sternum, the carpal and pelvic bones, and all the chevrons. The ends of the maxillæ are broken off, and probably the premaxillæ lack about two inches of their original length anteriorly. The ribs and phalanges are not accurately mounted. Cope's description of the type is quite accurate, but contains one error, namely, the assertion that the sixteenth vertebra from the last pair of ribs is the first which has a perforated diapophysis. It is in fact the seventeenth from the last pair of ribs, or the thirty-eighth vertebra in the series. Cope states that the total length of the skull axially is 101 inches. I am unable to make it more than 96½ inches, but about 2 inches should be added for the breakage of the tip of the premaxillæ, making 98½ inches in all. If Cope's measurement is correct, the skull must therefore have shrunk about 2½ inches. This is quite possible, owing to the drying of the bones and the bending down of the rostrum.[2] Cope's measurement of the breadth of the scapula is 29 inches. I make it 30 inches. The type-skeleton is figured on pl. 43. The following measurements of it were made by myself in May, 1900:

Skull:	*Inches*
Total length (straight)	96.5 [3]
Greatest breadth (at orbits)	65.75
Length of rostrum, least, straight	76.0
Breadth " at middle, curved	17.75±
Length of nasals	8.0 [4]
Breadth of the two nasals distally	7.5 [5]
Breadth of orbit from point to point, least	6.25

[1] A note (by Cope?) in the *Amer. Naturalist*, 12, 1878, p. 750, refers to the type as captured "near Philadelphia."

[2] In the table of measurements I have not used Cope's measurement, because the skull has doubtless shrunk in other directions as well.

[3] One or two inches should, perhaps, be added.

[4] Internal border; the external border is 10½ in.

[5] Only the left nasal is preserved. This is 3¾ in. broad opposite distal end of inner border. Twice 3¾ = 7½.

	Inches
Skull:	
Length of mandible, straight	92.0
" " " curved	101.5
Depth of mandible at the middle	7.0
Skeleton:	
Greatest breadth of atlas	18.25
" " 1st lumbar	26.25
Height of 1st lumbar, measured posteriorly	16.00
Depth of centrum of 1st lumbar	7.0
Greatest breadth of 1st caudal	22.0 [1]
Height of 1st caudal, measured posteriorly, and including process for chevron	19.5
Depth of centrum of 1st caudal	8.75 [2]
Breadth of scapula	30.0
Depth of scapula	23.0
Length of radius, with epiphyses	15.0
" " " without "	14.0
" " ulna with "	13.5
" " " without "	13.0
Breadth of radius at distal end	10.5
" " ulna " " "	8.0
Length of humerus, straight	14.0

The first vertebra with a perforated diapophysis is the 38th. The neural spine disappears on the 45th vertebra. The diapophyses are reduced to a mere swelling on the 41st vertebra; as distinct processes with concave anterior margins, the last are on the 37th vertebra.

Genus RHACHIANECTES Cope. 1869.

2. Agaphelus glaucus Cope. 1868.

"The California Gray Whale."

Rhachianectes glaucus (Cope). 1869.

Original description: Proceedings, Academy of Natural Sciences, Phila., 1868, No. 3, June–Aug., p. 159. Read June 23, 1868.

Type-locality: Coast of California.

Type-specimen: "A full set of baleen of one side of the maxillary" in the museum of Essex Institute, Salem, Mass.

Cope's original description of the California Gray whale was appended to a notice of the mythical "Scrag whale," for both of which he established the genus *Agaphelus*. The description is so brief that it may be inserted here in full:

"A second species of the genus [*Agaphelus*] was to be found in the 'gray whale' of the coasts of California. The baleen of this species, compared with that

[1] Twice one half.

[2] Anterior. Height of arch and spine of 1st lumbar, $9\frac{1}{2}$ in.; of 1st caudal, $9\frac{3}{4}$ in.

of the *A. gibbosus*, was longer and had narrower basis. The plates moderately and simply concave, while those of the latter are sigmoidal, most curved near the outer margin in cross section. The bristles of the California species were very coarse, varying from one to three series between the enamel plates. The bristles of the *A. gibbosus* much finer, three series together. Length of the latter 8.5 inches, width at base 4.4 inches. In the gray whale or *Agaphelus glaucus* Cope, 22 inches in length, width at base 6 inches. In the former nearly 6 in an inch, in the latter 2½. The baleen of the *A. gibbosus* belonged to an immature specimen of 35 feet in length." (*28*, 159–160.)[1]

In the same year, Cope mentioned the species again under the name of *Agaphelus glaucus* in a list of the Cetacea of the coasts of North America (*27*, 193).

A little later in the year 1868 he published a full description of two specimens observed at Monterey, Cal., Jan., 1866, by Mr. William H. Dall, and a set of whalebone in the Essex Institute. This was in an article entitled, "On Agaphelus, a genus of toothless Cetacea" (*26*, 226–227). The whalebone was that described earlier in the year, and must be considered as constituting the type-specimen. The Monterey specimens consisted of a nearly complete skeleton, and a specimen in the flesh, "killed by Killers (*Orca*)," sufficiently complete to allow of external measurements and notes on the external characters and coloration. Two skulls were obtained by Mr. Dall at Monterey, at a later date, one of which was deposited in the museum of the California Academy of Sciences, and the other in the National Museum (Cat. No. 13803, U. S. N. M.).

In 1869, Cope erected the genus *Rhachianectes* for this species (*83*, 15).

Genus BALÆNOPTERA Lacépède.

3. Sibbaldius tuberosus Cope. 1869.

Original description: Proceedings, Academy of Natural Sciences, Phila., 1869, p. 17. Presented for publication, March 9, 1869; published, July 20, 1869.

Type-locality: Mobjack Bay, Virginia, near the entrance of Chesapeake Bay, between York River and Rappahannock River, Aug. 11, 1858.

Type-specimen: Skeleton of "an adult male." Captured by Dr. P. A. Taliaferro and Prof. Edwin Taliaferro of William and Mary College, Williamsburg, Virginia, "and prepared and set up"—(where?).

A passing allusion to the specimen on which the species was founded was made by Cope in 1865 (*22*, 168). In 1866 he published a brief description of the specimen, drawn up by Prof. E. Taliaferro (*23*, 8), but referred it to his *Megaptera osphyia*, which he had described a short time before. Later in the same year he concluded that it represented the *Sibbaldius laticeps* of Gray (*24*, 297). It was not until 1869 that he finally decided that the whale represented a new species, which

[1] These numbers and all similar ones following refer to the bibliography at the end of the volume. The letters "sep." indicate that the paging is from a reprint or "separate."

he thereupon named *Sibbaldius tuberosus*. The account of it first given, in 1866, is as follows (*23*, 8):

"The whale alluded to (*Proceedings*, 1865, p. 168) as having been seen in Mobjack Bay, Virginia, was stated to have been captured by Dr. P. A. Taliaferro, of William and Mary College, Williamsburg, and prepared and set up. It is a short-finned *Megaptera*, probably of the species *M. osphyia*. Prof. T. has kindly furnished me with the following details as to its structure, carefully drawn up by himself.

"Length from end of muzzle over convexity of back, forty-three feet nine inches; girth about nineteen feet; length from end of muzzle to axilla (external measurement), fifteen feet; breadth of head across inferior margin of jaws, eight feet. Length of the pectoral extremity, *four feet;* greatest breadth fifteen inches; they were situated close behind the angle of the mouth. There were three hundred and sixty laminæ of baleen, extending on either side of the mouth about six feet along the jaw, the longest about eighteen to twenty inches. The head was acute. The folds of the throat many and capacious. The dorsal fin was represented by a conical mass covered by horny integument, without any membranous appendage, situated well posteriorly. The body near the tail very slender. The flukes suddenly expand to a breadth of ten feet. The cervical vertebræ were all distinct. Color: jet black above, white on the belly; sides beautifully marbled by the combination of the two colors.

"The most striking feature in this specimen is the shortness of the pectoral limbs, being relatively nearly half less than in the specimen of the *osphyia* at Niagara, one-half the length of the cranium, and only one-tenth the total. This is very different from any of the hitherto known species, and without doubt distinct."

Cope stated in 1866, as just quoted, that the skeleton had been prepared and set up, but did not say where, or by whom. Later in the same year he stated that the skeleton was in the museum of the Philadelphia Academy, but in 1869 remarked again that the deposit of the specimen in the Academy had been delayed, but was expected in a short time. He left it uncertain, therefore, whether the skeleton of the type was or was not in Philadelphia. In 1899, and again in 1900, I visited the Academy of Natural Sciences, and through the kindness of Dr. Dixon and Mr. Stone was enabled to look over all, or nearly all, the bones of whales then in the museum. I did not find any corresponding to *S. tuberosus*, and it would seem probable that the skeleton never reached Philadelphia. This view is strengthened by the fact that a writer in the *American Field* in 1889,[1] repeating the story of the capture of the whale, as he had heard it from the lips of Dr. Taliaferro, who pursued and killed the animal, proceeds as follows:

"I [Dr. Taliaferro] took the whalebone out of his mouth, and bade the servants help themselves to his blubber if they wanted to. . . . Although we got all the servants and dug huge holes and buried the carcass in sections, yet, like Banquo's ghost, it would not down. . . . His jawbones now ornament the doors of my [Dr. Taliaferro's?] carriage-house and I have several of his vertebræ, which come in handy as footstools."

[1] "Reynard," *American Field*, March 2, 1889, pp. 196–198.

If the bones had ever been got together and sent to Philadelphia, it would seem very probable that Dr. Taliaferro would have mentioned the fact. On the other hand, it is extremely difficult to understand how Professor Cope could give the detailed measurements and description of the skeleton, as published by him in 1866, unless he had had access to the specimen. They could, of course, have been furnished him by Dr. Taliaferro, but their character is such as to render this very improbable. In 1869 Professor Cope compared this whale with his *S. tectirostris* by external characters only, which characters he stated in 1866 were drawn up and furnished him by Dr. Taliaferro. He then remarked that as the specimen had not reached the Philadelphia museum, further comparison could not be made at that time (1869). It is certainly remarkable that Cope does not refer here to his detailed measurements and description of the skeleton, published in 1866. He could not have forgotten their publication, and one is, therefore, led to believe that there was something about them that barred them out. The only supposition which seems reasonable is that they were not really from the Mobjack Bay whale, but from some other specimen.

Considering the uncertainty regarding the skeleton, it may be best for the present purposes to rely entirely on the statements as to the external characters in our endeavor to ascertain the identity of *S. tuberosus*. Dr. Taliaferro's notes on the coloration, etc., published by Cope in 1866 (*23*, 8), furnish the following characters and measurements: Head acute. Pectoral ridges many and capacious. Dorsal fin represented by "a conical mass covered with horny integument, without any membranous appendage, situated well posteriorly." Body near tail very slender.

Length from end of muzzle over convexity of back	43 ft. 9 in.
Length from end of muzzle to axilla (external measurement)	15 " 0 "
Breadth of head across inferior margin of jaws	8 " 0 "
Length of pectoral	4 " 0 "
Greatest breadth of do	1 " 3 "
Breadth of flukes	10 " 0 "

Color "jet black above, white on the belly; sides beautifully marbled by the combination of the two colors."

"There were 360 laminæ of baleen, the longest about 18 to 20 inches."

In Dr. Taliaferro's story, as narrated by "Reynard" in the *American Field* in 1889, the color is thus referred to:

"For a half second that mighty fish, with back arched and immense fins quivering straight out from its side, was hung in mid-air not fifteen feet from me. I caught sight of him on the gleaming white of his side, just under his flipper, and fired. . . .

"As I said before, his immense flippers were quivering straight out from him, and there was a line of demarkation down his side where the gleaming white of his belly joined his marbled, grayish black back. . . .

"When I thought he ought to be aground, the first thing I saw was his white belly turned up."

Upon reducing the foregoing measurements to percentages of the total length, we find that the distance from the end of the snout to the axilla is 34.3%. In Newfoundland specimens of the "Common Finback," which is closely allied to or identical with *Balænoptera physalus*, as will be seen later, the average for this distance is 33.2% of the total length. The length of the pectoral (presumably from the axilla) is 9.1%. In nine Newfoundland specimens of the Common Finback the average is 8.3%. The breadth of the pectoral is 2.7% as against 2.9% in Newfoundland specimens.

The color of *S. tuberosus* is given in the original description as "jet black above, white on the belly; sides beautifully marbled by the combination of the two colors." In the story in the *American Field*, however, the color is thus described (see p. 83): "There was a line of demarkation down his side where the gleaming white of his belly joined his marbled, grayish black back." The latter description was, of course, from the fresh specimen while the former was probably from the dead whale. It is a well-known fact that the gray color in cetaceans changes very rapidly after death to black. Taking either description, there is no reason for considering *S. tuberosus* to be other than the Common Finback of North American waters.

Considering the external characters and proportions as a whole, it seems probable that the Mobjack Bay specimen was a Common Finback, which is the American representative of, or identical with, *Balænoptera physalus* (L.).

There is only one other well-known North Atlantic Finback with which the Mobjack Bay specimen can be associated. This is *B. borealis*. In this species, however, the dorsal fin is situated well forward, the pectoral fins are unusually small, and the amount of white on the belly is much restricted. None of these characters was present in the Mobjack Bay specimen, as far as can be ascertained from the published accounts.

The question of the identity of *S. tuberosus* cannot be positively decided until some of the more important bones of the Mobjack Bay specimen are found and examined. In the present article I shall consider it as belonging to the American form of *B. physalus* (L.).

In order to present the matter fully and fairly, I would add the following: If all that Cope stated regarding the skeleton which he described in 1866 is taken as really applying to the Mobjack specimen, and all that was added to the original description of the exterior in the later papers is interpreted favorably, quite a strong case can be made out for identifying *S. tuberosus* with *B. borealis*, or at least associating it with that species. Thus, while the color of the baleen is not given in the original description, in the article of 1866 it is said to be black, which would indicate an ally of *B. borealis*, and exclude *B. physalus* (L.). In the same article, the type of *S. tuberosus* is stated to be "entirely adult at a length of 43 feet (axial)," which would exclude both *B. musculus* (L.) and *B. physalus* (L.), but admit *B. borealis*. Again, in the description of the skeleton, it is stated that "the 2^{d}, 3^{d}, and 4th cervicals are with large completely united superior and inferior lateral processes." This would confirm the statement that the speci-

men was adult. It can also be argued that the black color of the body was the living color and not due to change after death, which strengthens the case in favor of *B. borealis*.

In spite of these apparent agreements with *B. borealis*, my own opinion, as already stated, is that *S. tuberosus* is to be associated with *B. physalus*. It was assigned by Van Beneden in 1889 (*7*, 205) to *B. borealis*, but his evidence was presumably derived entirely from Cope's description.

4. Sibbaldius tectirostris Cope. 1869.

Original description: Proceedings, Academy of Natural Sciences, Phila., 1869, p. 17. Presented for publication, March 9, 1869; published, July 20, 1869.

Type-locality: Near Sinepuxent Bay, Maryland. Came ashore in the winter of 1868–69; had been dead some time.

Type-specimen: Nearly complete skeleton of a young female between forty-seven and forty-eight feet long, preserved in the museum of the Philadelphia Academy of Natural Sciences.

The history of this species is, fortunately, quite clear. The individual which formed the type was a young female which came ashore near Sinepuxent Bay, Maryland, in the winter of 1868–69. It had been dead some time when found. The carcass was stripped by Joshua Carey. The skeleton is in the museum of the Philadelphia Academy of Natural Sciences, where I saw and measured it in 1899. It is nearly complete. The characters given by Cope for the specimen (*83*, 16–20) are as follows:

Dorsal fin of ordinary form, compressed, with a long base, and situated two-thirds the length from the muzzle; dorsal line behind it smooth.

Color above uniform black; exterior face of pectorals and "stripes along the gular plicæ" also black. Belly white, separated abruptly from the black, forming a "water line." Posterior (inner?) face of pectorals in the distal half, and under surface of flukes white.

Baleen short, of a dark lead color, the inner and shorter margin white for varying widths; bristles fine.

Skeleton.—"The individual is in the young stage, since not only are all the epiphyses of the vertebræ separated, but those of the humerus also."

"The axis presents below no surface adapted to a *tuberculum atlantis*. The median portion of the anterior face of the centrum presents a low conic projection, the *processus odontoideus*. The di- and parapophyses are united distally, embracing a large ring, whose outside longitudinal diameter is $\frac{2}{3}$ the transverse diameter of the centrum of the same. The neural arch presents no spine, but a pair of lateral prominences like rudimental zygapophyses. The parapophyses of the remaining cervicals are long, except on the seventh, where they are almost wanting. The diapophyses are long in all, longest and decurved on the seventh, where it stands above the parapophysis of the sixth. They are nearly united with the parapophysis on the third cervical, and are no doubt fully so in mature age. The fourth cervical is lost, but it is scarcely probable that it presented a complete ring for the transmissal of the vertebral artery, etc. There are no rings attached to the vertebræ from the fifth inclusive. The centra are all transversely oval."

"There is no neural spine on the second, third and fourth cervicals, and it is rudimental and small on each of the remainder. Those of the dorsals and lumbars are not particularly elevated.

"The humerus is very short and thick, and the hand remarkably small.

"The scapula, as in other *Sibbaldii*, has a considerable antero-posterior extent, and well developed acromion and coracoid. The disk is divided into three areas on the inside by two slight ridges."

"The muzzle is elongate, and with a narrow acumination. Each nasal is as wide as long medially; anteriorly concave above, the line of junction of the two in one plane, forming a median ridge, which is prolonged into a prominent median point. The otic bullæ are slightly compressed and carinate below, and their surface is not markedly rugose. The malars are in shape something like first ribs; that is, with an enlarged head, with prominences imitating capitulum and tubercle, a short narrowed shaft, and expanded distal extremity. The distal third is occupied by an ovate ? articular surface, thinning out the margin on one side. The shaft is thin and concave, both longitudinally and transversely, on one side.

"The inner margin of the palatine bones is regularly continuous with the short pterygoids, which are very short, and do not approach near the otic bullæ; Rudolphi represents the latter as prolonged to beyond the extremity of the bulla. The posterior plate of the vomer in *S. tectirostris* extends much further posteriorly than Rudolphi represents for *S. laticeps*, and though there is no doubt some variation in this respect in the same species, the difference here is considerable. In *S. laticeps* it extends to a little behind the anterior margin of the bulla; in *S. tectirostris* to behind the posterior margin, concealing much of the basioccipital.

"The mandibular ramus is strongly curved, and very convex externally, less so internally. The vascular foramina are very large externally, and very much reduced in size on the inner face. The coracoid process is strongly elevated, curved outward, and acuminate. There is a distinct angular process below the condyle." (*83*, 17–19.)

I have verified the majority of Cope's measurements, and give them below in the order in which they occur in the original, together with such differences as I noted. For purposes of comparison I shall repeat some of them later in a different order, with other measurements of my own taken in accordance with a particular system.

SIBBALDIUS TECTIROSTRIS COPE. (TYPE.)

Measurement.	Cope's measurements, 1869.	My measurements, 1899.
Total length of skeleton (restored)	45 ft. 7 in.	——[1]
Length of cranium	120 in.[2]	121 in.
Height of centrum and arch of axis	12.25	12.25
" " centrum [do.]	7.1	7.0
Transverse extent of axis	25.0	25.0
" " " centrum of do.	11.5	12.0
" " " neural canal [of do.]	5.75	5.75
" " " third cervical	23.0	22.0

[1] Not re-measured by myself.

[2] Given in another place as 126 in.

SIBBALDIUS TECTIROSTRIS COPE. (TYPE.) (*Continued.*)

Measurement.	Cope's measurements, 1869.	My measurements, 1899.
Transverse extent of centrum do. [3d cervical]	11.0	11.0
Length parapophysis sixth cervical	5.0	—[1]
Vertical diameter centrum (5th ?) dorsal	7.0	—[1]
Length centrum do.	6.0	—[1]
Vertical diameter centrum second caudal, with perforate diapophyses	10.5	—[1]
Length of centrum do	10.5	—[1]
Height, spine and arch, middle lumbosacral	14.5	—[1]
" from floor canal to top anterior zygapophysis	6.0	—[1]
Scapula, antero-posterior width	33.0	33.0
" vertical width	21.0	20.0
Length of acromion	7.5	8.0
" " coracoid	4.5	—[6]
Diameter of glenoid cavity	8.0	8.5
Length of cranium (axial)	126 in.[2]	121.0
Greatest width of occipitals	43 0	—[1]
Width at supraorbital plate	52.0	52.5
" of each maxillary at middle	9.75	9.75[3]
" of supraorbitals above orbit	13.0	12.0[4]
" (least) of frontal region	13.5	14.0
" of nasals	4.3	6.25[5]
" intermaxillaries at middle	5.3	4.33
Length, nasal	6.0	6.75
" maxillary above	90.0	90.0
" ramus mandibuli (in curve)	120.0	120.0
" " " to coronoid	19.0	—[1]
Depth " " at condyle	8.5	—[1]
" " " at coronoid	13.0	—[1]
" " " at middle	9.0	9.5
Length, otic bulla	5.2	—[1]
Length of longest plates of whalebone with gum	15.0	—[1]
Width do. at base	10.0	—[1]

It is, I think, proper to assume that the type of *S. tectirostris* is nothing more or less than a specimen of the "common Finback" of the Atlantic coast of the United States. Cope, at the time of original publication, was probably not in possession of the fact that the Finback which strands most frequently on our coast is of the fashion of *B. physalus* (L.). He considered his specimen most closely allied to *Sibbaldius laticeps* of Gray (= *B. borealis* Lesson), but, as might be expected, he found numerous differences. At a later date, in consequence of his own more extended studies, and the progress of cetology, he perceived that *tectirostris* was properly to be associated with, or might even be identical with, *B. physalus*. Cope also considered his *S. tuberosus* allied to *S. laticeps* of Gray and for a time identified it with the latter species. But at the same time he pointed out two external characters by which he supposed it differed from *tectirostris*, — the form of the dorsal fin

[1] Not re-measured by myself. [2] Cope gives 120 in. on another page.
[3] If the nasal process of the maxilla is taken into account; otherwise, 9 in.
[4] This is the greatest breadth; the least is 8.75 in.
[5] This is the width at the distal end. Cope's measurement was probably taken at the proximal end, for which it is correct. [6] The coracoid is broken.

and the character of the dorsal line. He appears to have intended also to point out osteological differences between *tectirostris* and *tuberosus*, but the language employed is so ambiguous that this is uncertain. There is, furthermore, a doubt whether he ever really examined the skeleton of *tuberosus*, as will be explained later.

The position which I take regarding *tectirostris* is (1) that Cope at the time he first described it did not evince any knowledge of the fact that one kind of Finback is common on the east coast of the United States, and that (2) there is, therefore, no probability that he intended to establish a second species similar to, but somewhat different from, the common species; consequently, that (3) the type-specimen of *tectirostris* does not merit any more attention than other specimens of the common Finback, unless on comparison of them all together the type of *tectirostris* seems to stand apart from the others. As to whether the latter condition is found will be fully considered later. What we really wish to ascertain is whether the common Finback of the Atlantic coast of the United States is the same as, or different from, *B. physalus* (L.) of Europe. The type-skeleton of *B. tectirostris* is figured on pls. 1, 2, 4, 5, and 6.

The following measurements of the type-skeleton made by myself in 1900 include those made uniformly for all the specimens examined, and others which appear to be of importance in this particular case:

SIBBALDIUS TECTIROSTRIS COPE. (TYPE.)

Skull:	*Inches.*
Total length (straight)	121.0
Greatest breadth (squamosal)	54.0
Breadth of orbital process of frontal at distal end	8.75 [1]
Length of rostrum (straight)	80.75
Breadth of rostrum at middle (curved)	26.5 [2]
Length of nasals in median line	7.5
Breadth of the two nasals at the distal end	5.5 [3]
Length of mandible, straight	111.0
" " " curved	120.0
Depth of mandible at middle	9.5
Skeleton:	
Greatest breadth of axis	25.0
" height " "	13.25 [4]
Depth of centrum of axis	7.0 [5]
Greatest breadth of 1st dorsal	22.75
" height " " "	13.25
Depth of centrum of 1st dorsal	7.25 [6]
Greatest breadth of 1st lumbar	32.0
" height " " "	21.5 [7]
Depth of centrum of 1st lumbar	7.75 [7]
Greatest breadth of 1st caudal	24.0 [8]
" height " " "	21.0 + [7]
Depth of centrum of 1st caudal	9.25 [9]
Greatest breadth of scapula	32.75
" depth " "	19.5
Length of acromion, inside (straight)	7.0
Length of radius, with epiphyses	24.0
Length of radius, without epiphyses	23.0
" " ulna, with epiphyses	22.25
" " " without epiphyses	21.5
" " humerus (straight)	15.0

[1] Tip to tip, least.
[2] As mounted.
[3] Opposite distal end of inner margin.
[4] Median = 12.25 in.
[5] Median, posterior.
[6] Median, anterior.
[7] Posterior.
[8] Twice one half.
[9] Anterior.

Cope's description of the type-skull is accurate, except that the nasals are longer than wide. The two together are as wide distally as each is long. The length of the maxilla from the tip to the end of the nasal process is 89 inches; breadth across the frontal summit, $13\frac{3}{4}$ inches; palatines, $21\frac{3}{4}$ inches long in the median line, measured in a straight line; the glenoid fossa of the squamosal from tip to tip in a straight line, 22 inches.

The atlas is wanting, also the 7th cervical, not the 4th, as stated by Cope. The processes of the axis form a complete bony ring, enclosing an oval foramen, the long axis of which measures 5 inches. The greatest width of the bony ring itself is 4 inches; distance from edge of anterior articular facet to outside of ring, $8\frac{1}{2}$ inches. The superior transverse processes of the 3d, 4th, and 5th cervicals are broken; also, the inferior processes of the 5th cervical. The length of the processes in the cervical vertebræ present (in straight lines) is as follows:

SIBBALDIUS TECTIROSTRIS COPE. (TYPE.) CERVICAL VERTEBRÆ.

No. of cervical.	Superior process.		Inferior process.	
	Right.	Left.	Right.	Left.
	In.	In.	In.	In.
3	(broken)	(broken)	6.25	5.5
4	"	"	6.5	5.5
5	"	"	(broken)	(broken)
6	6.5	6.5	1.5	1.25[1]
7	—	—	—	—

The breadth of the right radius at the distal end is $5\frac{1}{2}$ in.; of the left, the same; at the proximal end, $5\frac{3}{4}$ in. in both. Breadth of the right ulna at the distal end, 4 in.; of the left, $4\frac{1}{4}$ in.; at the proximal end (including the olecranon), right, $5\frac{3}{4}$ in., left, 6 in.

Not many months after Cope prepared the original description of *S. tectirostris*, he inserted in the *American Naturalist* the following brief notice of the type-specimen:

"NEW FINNER WHALE.

"(*Sibbaldius tectirostris.*)

"The Academy of Natural Sciences has just obtained the perfect skeleton of a whale from the coast of Maryland. It is a finner, of the genus *Sibbaldius* Gray, and is half-grown and forty-seven feet in length. It is quite distinct from all known species, but is nearest *S. laticeps*. Its characters are found in the nasal and *phenygoid* [*sic*] bones, and in the cervical vertebræ, etc. I call it *S. tectirostris*. Two cervicals only have complete lateral canals; the nasals are short, wide, concave in front, except a prolonged keel in the middle line above, and in front.—Edward D. Cope, Philadelphia."[2]

[1] (Broken) ?

[2] *Amer. Nat.*, No. 5, July, 1869, pp. 277–278.

5. Balænoptera velifera Cope. 1869.

"The Finner Whale of the Oregon Coasts."

Original description: Proceedings, Academy of Natural Sciences, Phila., 1869, p. 16. Presented for publication March 9, 1869; published July 20, 1869.

Type-locality: Oregon Coasts. No type. Described from Scammon's observations and sketches. A northern and a southern form mentioned, but not described, or named.

The original description is as follows:

"The Finner Whale of the Oregon coasts.

"This species differs from all that have been described in that respect, in the color of the baleen; from the *B. arctica* of the Japanese Seas, the coloration of the body separates it; in the latter the sides are spotted black and white, in the present shaded from the brown of the upper to the white of the lower surfaces. The large size of the dorsal fin and its anterior position are marked characters; the northern species, with larger fin, is still more different from the *B. arctica*, the only one with which it would be probably identical.

"The more southern form, with very small fin, may be another species—possibly a *Sibbaldius*. The *B. velifera* cannot, unfortunately, be compared with the *B. swinhoei* and *B. patachonica*, as no similar parts are figured or described.

"The baleen, says Capt. Scammon, is of a light lead color, streaked with black, and its surface is marked with transverse roughening. In the *B. physalus* the whalebone is, according to Gray, slate-colored on the inner side, white streaked; on the outer side nearly black, and with still darker streaks. In the *B. rostrata* it is nearly all white, with some black at the base." (*83*, 16.)

In the list of cetacea by Mr. Wm. H. Dall, which is appended to Scammon's work (*83*, 303), it is stated that baleen of *B. velifera* is in the museum of the Smithsonian Institution. I regret that I am unable to find any such specimens, or record of their receipt, though there are many specimens of whalebone of other species, received from Scammon.

6. Sibbaldius sulfureus Cope. 1869.

"The Sulphurbottom of the Northwest Coast."

Original description: Proceedings, Academy of Natural Sciences, Phila., 1869, p. 20. Presented for publication March 9, 1869; published July 20, 1869.

No type. Described from data furnished by Scammon, as follows:

"The Sulphur-Bottom of the North West Coast. This immense whale is as yet too insufficiently known to be distinguished as fully as desirable, but the marked peculiarity of coloration separates it from the only species with which a comparison is necessary—the *S. borealis* or *gigas* of the North Atlantic. Capt. Scammon describes it to be gray or brown above, paler than in *Balænoptera velifera*, and beneath, a sulphur yellow. Length from 70 to 90 feet. The colors of the *S. borealis* are described as polished black above, milky white beneath, by Dubar."

7. Balænoptera davidsoni Scammon. 1872.

Original description: Proceedings, California Academy of Sciences, 4, No. 20, Jan., 1873, pp. 269–270. Printed in advance, Oct. 4, 1872.

Type-locality: Admiralty Inlet, Washington, Oct., 1870. Female, 27 feet long, with fœtus, 5 ft. long.

Type-specimen: Skull No. 12177, U. S. National Museum. (See pl. 23, fig. 1; pl. 25, fig. 1; pl. 26, fig. 1.)

The original description is as follows:

"Above, dull black; body, pectoral and caudal fins white below, with a white band across the upper surface of the pectorals near their bases. Gular folds, seventy in number; the interspaces having a pinkish cast, though the more prominent portions are of a milky white. Head pointed; dorsal fin small, falcate, placed two-thirds the length of the body from the end of the beak. Pectorals small, narrow, placed one-third of the animal's length from the anterior extremity. Genitalia opening below and slightly behind the anterior edge of the dorsal fin. Baleen pure white; laminæ on each side, two hundred and seventy in number; the longest not exceeding ten inches. Total length of animal twenty-seven feet; pectorals four feet long, thirteen inches wide; spiracles three feet eight inches behind the end of the beak; pectorals, ditto, eight feet six inches; anterior edge of dorsal, ditto, fifteen feet six inches; posterior edge, ditto, eighteen feet. Height of dorsal, ten inches; breadth of flukes, from point to point, seven feet six inches; width of lobes of the same, twenty-five inches. From the fork of the caudal fin to the anus, eight feet four inches; ditto to opening of vagina, nine and a half feet. Anterior end of snout to corner of mouth, four feet eight inches.

"Distribution from Mexico to Bering Strait; on the west coast of America.

"The specimen from which this description was taken was obtained in Admiralty Inlet, Washington Territory, October, 1870. It was a female, and contained a fœtus five feet long; thus correcting the error of the whalers, who commonly regard this small species as the young of the 'finback' of the coast. The skull has been deposited in the National Museum at Washington." (*81*, 269–270.)

Genus MEGAPTERA.

8. Megaptera osphyia Cope. 1865.

"Hunchbacked Whale of our [Atlantic] Coast."

Original description: Proceedings, Academy of Natural Sciences, Phila., 1865, p. 180. Offered for publication Sept. 19, 1865; published in 1865.

Type-locality: Forty miles from Petit Manan lighthouse, Maine.

Type-specimen: Skeleton from individual 50 ft. long, found dead at sea and towed to shore by Capt. Taylor. Skeleton mounted and preserved in museum at Niagara Falls, New York.

This species was based on a skeleton of a Humpback found dead at sea,[1] 40 miles from Petit Manan lighthouse, Maine, in July, 1844. It was mounted and

[1] A printed label now (1900) on the skeleton reads: "Captured by Capt. J. Bickford, of the ship *Fulton*."

exhibited in the popular museum at Niagara Falls, formerly on the Canadian side, but now located on the American side. Cope examined it at some time prior to 1865, and in that year described it as representing a new species. He recognized that it belonged to the genus *Megaptera*, but considered that it differed in several important characters from *M. longimana* (Rudolphi).

The original description, which is too long to quote in full in this place, applies well, except in a few particulars, to a skeleton 33 ft. 10 in. long, in the National Museum (No. 21492) from Cape Cod, Mass., which, as will be shown later, agrees closely with European specimens of *M. longimana*. One of the differences noted in the description is that in the type of *M. osphyia* the superior transverse processes of the cervical vertebræ increase in length from the 3d to the 5th, while in skeleton No. 21492, they rather decrease than increase. An examination of the type shows this distinction to be of little importance, as the processes are shorter posteriorly on one side and longer on the other.[1] Cope wrote at a time when Gray's opinion that the differences in the length and shape of the processes of the cervical vertebræ furnished reliable specific characters was generally accepted. Later researches have shown that these processes vary greatly in the same species.

In the description of the type of *M. osphyia* well-developed inferior transverse processes are said to occur on the 3d, 4th, 5th, and 6th cervicals; "that of the fifth, three-fifths the diameter of the centrum." An examination of the type bears out this statement. In skeleton No. 21492 there are inferior transverse processes on the right side of the 3d, 4th, and 5th cervicals, but none on the 6th; and that on the 5th is not more than $\frac{1}{3}$ the diameter of the centrum in length. That this difference is unimportant, however, is shown by the fact that there are no inferior processes whatever on the *left side* of the last five cervicals (3d to 7th) in this same skeleton.

A most extraordinary statement in the description of the type of *M. osphyia* is as follows: "The neural arches and spines are remarkably elevated on the dorsal and lumbar regions, somewhat as in the Catodontidæ; *e. g.*, in the 33d vertebra, the vertical diameter of the centrum is 9.75 inches, and the height of the arch and spine, 17.87 inches, or nearly double." Again, Cope remarks: "A most striking peculiarity of the species is the great elevation of the arches and spinous processes of the dorsal, and especially the lumbar vertebræ, reminding one of the structure in the toothed whales. The outline of the skeleton is thus somewhat humped behind, presenting a contrast to that represented by Rudolphi in the type specimen of the *longimana*, where the elevation of the arches and spines does not exceed the diameter of the centrum, on the lumbar region at least."

As I remarked in 1884 (*89*, 642), after having seen the type, these statements appear to have been due to a misapprehension. In the type the vertical diameter

[1] The figures for the superior transverse processes in the type are as follows (see p. 96):

	Right.	*Left.*
3d cervical	(broken)	(broken)
4th cervical	$7\frac{1}{2}$ in.	$7\frac{3}{4}$ in.
5th cervical	$7\frac{3}{4}$ in.	$7\frac{1}{2}$ in.

(posteriorly) of the centrum of the 33d vertebra is 12 inches, and the neural arch and spine 13½ inches, making a total of 25½ inches. The height of the arch and spine is, therefore, about equal to the depth of the centrum, and not "nearly double," as stated in the original description. In skeleton No. 21492 the diameter of the centrum of the 34th vertebra[1] is 9.75 inches, and with the neural arch and spine the total height of the vertebra is 18 inches. This character of the lumbar and caudal spines is clearly fictitious, and as it was really the principal one on which the species *osphyia* was based, we are justified in the assumption that the type represents the ordinary Humpback of our Atlantic coast, and is to be so regarded unless other characters than those enumerated by Cope can be detected.

In 1884, Cope in reviewing my Catalogue of Aquatic Mammals, above mentioned (*30*, 1123–1124), took exception to this view, and accused me of inaccuracy in stating that the high neural spines had been put forward as the principal character of the species. He quoted from his original description, as follows: "The shorter head and fins, the peculiarly high neural spines[2] and peculiarities of some of the cervical vertebræ, would seem to distinguish this [species] from the *longimana*." As, however, a *Megaptera* with the skull "one-fifth, or less" the total length, and the flipper "one-fifth" the total length, as first reported by Cope, would be a decided anomaly, I regarded these dimensions with suspicion, and an examination of the skeleton showed that they were due to the imperfection of the specimen. The characters of the cervicals mentioned by Cope, in so far as they differ from those of any specimen of *Megaptera*, seemed to be of little importance, as above noted. The supposed great elevation of the neural spines of the dorsal and lumbar vertebræ[3] seemed possible, and hence the really important character; and so, indeed, it would be, if established.

In 1868 Cope (*27*, 194) made further reference to the type, stating that the skeleton (as it then was) measured 34 feet, but that as it lacked some of the caudal vertebræ and the intervertebral cartilages had shrunk, the proper length was perhaps 42 feet. He describes several additional features of the skull and skeleton, all of which are to be found in the specimen in the National Museum, No. 21492, except that which relates to the union of the neural arches of the 3d and 4th cervical vertebræ. This is, however, an individual rather than a specific character.

In 1871, in describing another species (*29*, 107), Cope makes a few additional comments on *M. osphyia*. He remarks that in this species "the head and fin are even shorter than in *M. longimana*, and the coronoid process equally rudimentary. . . . The width of the orbital plates [orbital process of the frontal] distally is .5 their length in the type of *M. osphyia*." As regards the orbital process of the frontal it is to be remarked that the proportions given by Cope for *M. osphyia* are the same in the two skulls in the National Museum (Nos. 21492 and 16252) from

[1] The 33d cannot be measured.

[2] This refers to the spines of the dorsal and lumbar vertebræ, and not to those of the cervicals. F. W. T.

[3] And also of the caudals, as Cope mentions particularly the 33d vertebra among them. It is really the 2d caudal.

Cape Cod, Mass. The coronoid process of the mandible is prominent in both these specimens, and in No. 21492 increases the total depth of the jaw from 10 inches to 12 inches, though as it is strongly inclined outward, the vertical height of the process itself exceeds 3 inches. In *M. longimana*, furthermore, if Struthers's specimen is to be regarded as representing that species, the coronoid is not inconspicuous. Struthers's measurements are—anterior margin $1\frac{1}{2}$ inches, posterior margin $3\frac{1}{4}$ inches. As no measurements are given by Cope for *M. osphyia*, it is difficult to estimate the exact import of the word "rudimentary" which he employs. An examination of the type shows that the coronoids have been cut off at the top. Whether they were in this condition when Cope saw them is uncertain, but probable. The coronoid is, of course, less well developed in the Humpbacks than in the Finbacks.

We have now reviewed all that has been recorded of the type of *M. osphyia*, and it will be conceded, I think, that there is no reason to suppose that it should be separated from other specimens from the Atlantic coast of the United States, as a distinct species. Whether the American species is different from the European *longimana*—the main question at issue—will be considered later.

The type-skeleton of *M. osphyia* is figured on pl. 36. As already stated, it was formerly in a small museum on the Canadian side of Niagara Falls, but has now been removed to a new museum building near the Cataract Hotel on the American side. A written label on the skeleton reads:

"Skeleton of a whale 50 ft. long. Caught by Capt. Bickford, of the ship *Fulton*, near the Petit [Manan] Lighthouse, on the coast of Maine, July, 1844. It weighed about 70 tons. The jaw bones measured 12 feet. 18 people can sit in its mouth. It was towed into Birch Harbor, and there prepared for exhibition. It is the only specimen of its kind known."

A printed label says: ". . . weighing about 70 tons, it was captured by Captain J. Bickford, of the ship *Fulton*, on the coast of Maine, 40 miles at sea. Petit Manan Light House, July, 1844," etc.

The skeleton is mounted with all the vertebræ, except the atlas, reversed. The curvature of the dorsal region is exaggerated. Each pectoral limb has three digits, and three phalanges in each digit (exclusive of metacarpals), an entirely artificial arrangement.

Actual measurements of the skeleton, made by myself in 1900, are as follows:

MEGAPTERA OSPHYIA COPE. (TYPE.)

Skull:	*Inches.*
Total length (straight)	135.0
Greatest breadth (squamosal)	78.5
Post-squamosal breadth	66.0
Breadth of orbital process of frontal at distal end, least	9.5
" " " " " " greatest	14.0
Length of rostrum (straight)	89.0
" " at middle (curved)	31.5
Length of mandible (straight)	129.0
" " " (curved)	144.0
Depth of mandible at middle	11.5

Skeleton:	*Inches.*
Total length, as mounted, straight (35 ft., 5 in.)	425.0
Greatest breadth of axis	26.0
Depth of centrum of axis	7.0
Greatest breadth of 1st dorsal	24.0
Depth of centrum of 1st dorsal	8.?
Greatest breadth of 1st lumbar	38.0
Depth of centrum of 1st lumbar	10.?
Greatest breadth of 1st caudal (32d vertebra)	29.0
Depth of centrum, 1st caudal	12.5
Breadth of right scapula	42.0
Breadth of left scapula	42.25
Depth of scapula	29.5
Length of right radius along center, with proximal epiphyses	34.5
Length of left radius along center, with proximal epiphyses	34.5
" " right " " " without epiphyses	32.5
" " left " " " " "	32.75
" " ulna with epiphyses	34.0
" " right ulna, without epiphyses	28.5
" " left " " "	28.5
Length of humerus (straight)	21.0
" " " without epiphyses	13.0
Length of glenoid fossa of scapula	13.0
Breadth " " " " "	9.5
Length of longest rib	60.0

In connection with his original description of the type-skeleton, Cope recorded a number of measurements, some of which are taken from the same points as those above, and others from different points. Thus, the length of the fore-limb is given as 9.05 feet, which is, of course, erroneous, and due to the incorrect mounting of the skeleton. The breadth of the cranium between the orbital processes of the frontals is given as 6.41 feet, and the breadth between the coronoids of the mandible, 5.75 feet. The height of the scapula is recorded as 29.6 inches, and its breadth, as 44.4 inches, which, it will be seen, are close approximations to my own measurements as given above.

In the type-skeleton of *M. osphyia* all the epiphyses are unattached. Those of the vertebræ are held together in pairs by the dried intervertebral cartilage. A few are wanting. The vertebræ present are as follows: C. 7, D. 14, L. 10, Ca. 17 = 48. Fourteen ribs are present on the right side and thirteen on the left side. Cope mentioned fourteen pairs of ribs, so that it is possible that one rib has been lost since he examined the skeleton.

Skull.—The nasal bones are wanting. The anterior border of the orbital process of the frontal is nearly straight. The breadth of the skull between the distal extremities of the orbital processes is six feet five and one-half inches. The occiput is swollen laterally, with a quite deep central depression and a small median ridge. The coronoid processes of the mandible are low and blunt, but the tips have, as already stated, apparently been cut off.

Vertebræ.—The antero-posterior length of the centra of the vertebræ present, without the epiphyses, is as follows:

MEGAPTERA OSPHYIA COPE. (TYPE.) LENGTH OF CENTRA OF VERTEBRÆ.

Vert. No.	Inches.	Vert. No.	Inches.	Vert. No.	Inches.	Vert. No.	Inches.
1	4	13	4	25	6	37	$6\frac{3}{4}$
2	2	14	$4\frac{1}{4}$	26	$6\frac{1}{4}$	38	$6\frac{1}{2}$
3	$1\frac{1}{2}$	15	$4\frac{1}{2}$	27	6	39	$5\frac{1}{2}$
4	1	16	$4\frac{3}{4}$	28	6	40	$5\frac{1}{2}$
5	$1\frac{1}{4}$	17	5	29	$6\frac{1}{2}$	41	5
6	$1\frac{1}{2}$	18	5	30	$6\frac{3}{4}$	42	$3\frac{1}{2}$
7	$1\frac{1}{2}$	19	5	31	7	43	3
8	2	20	5	32	$7\frac{1}{2}$	44	3
9	$2\frac{1}{4}$	21	5	33	$7\frac{1}{2}$	45	$2\frac{3}{4}$
10	$2\frac{3}{4}$	22	$5\frac{1}{4}$	34	$7\frac{1}{2}$	46	$2\frac{1}{2}$
11	$3\frac{1}{4}$	23	$5\frac{1}{2}$	35	$7\frac{1}{4}$	47	$2\frac{1}{4}$
12	$3\frac{3}{4}$	24	$5\frac{1}{2}$	36	7	48	$2\frac{1}{4}$

The antero-posterior length of a pair of epiphyses, with the dried cartilage between, is $1\frac{3}{4}$ inches.

The transverse process of the atlas is 6 in. deep, $4\frac{1}{2}$ in. long. In the other cervical vertebræ from the third to the seventh inclusive, the length of the processes is as follows:

MEGAPTERA OSPHYIA COPE. (TYPE.) LENGTH OF PROCESSES OF CERVICAL VERTEBRÆ.

Cervical No.	Processes.			
	Superior.		Inferior.	
	Right.	Left.	Right.	Left.
	In.	In.	In.	In.
3	(broken)	(broken)	$5\frac{3}{4}$	6
4	$7\frac{1}{2}$	$7\frac{3}{4}$	$4\frac{1}{2}$	$4\frac{1}{4}$
5	$7\frac{3}{4}$	$7\frac{1}{2}$	5	$4\frac{1}{2}$
6	$8\frac{1}{2}$	8	3	$3\frac{1}{4}$
7	8	$8\frac{1}{2}$	(none)	(none)

The lateral processes of the axis are long, but do not meet at the distal ends. The inferior processes are as long as those of the third cervical. The vertical diameter of the fifth cervical is $8\frac{1}{4}$ in.

The height of the neural arch and spine of the first dorsal vertebra is $8\frac{1}{2}$ in.; of the seventh dorsal, 13 in. The depth of the centrum in the latter vertebra is $8\frac{3}{4}$ in.

The height of the neural arch and spine of the first ten lumbars, measured from the top of the centra posteriorly, is as follows:

MEGAPTERA OSPHYIA COPE. (TYPE.) HEIGHT OF NEURAL ARCH AND SPINE OF LUMBAR VERTEBRÆ.

Lumbar No.	Inches.	Lumbar No.	Inches.
1	$16\frac{1}{2}$	6	$17\frac{1}{2}$
2	$16\frac{1}{2}$	7	$17\frac{1}{2}$
3	17	8	$17\frac{1}{2}$
4	18	9	$16\frac{1}{2}$
5	$17\frac{1}{2}$	10	16

The same measurement for the first lumbar, taken *anteriorly*, is 17¼ in.; for the tenth lumbar, 16 in. The depth of the centrum of the first lumbar (Vert. No. 22) is 9½ in.; of the tenth lumbar, 11¼ in.

The total height of the second caudal vertebra (Vert. No. 33), measured anteriorly, is 26 in.; posteriorly, 25½ in.; height of neural arch and spine, anterior, 13½ in.; posterior, 13¼ in.; top of zygapophysis above top of centrum, 5½ in. Height of neural arch and spine of first caudal, 15 in. Diameter of last caudal in position, 4 in. in either direction. The caudal series is incomplete. The skeleton shows places for 10 chevrons. Seven are in position.

As already stated, the skeleton, as at present mounted, has 14 right ribs and 13 left ribs. The first right rib has a length of 36 in., measured in a straight line from the center of the distal end; greatest breadth at the distal end, 9 in. Length of first left rib, 37 in.; breadth at distal end, 7¼ in.

The total length of the right pectoral limb as mounted is 106½ in.; of the left, 107½ in. The breadth of the radius at the proximal end is 8½ in.; at the distal end, 13 in.; breadth of the ulna at the proximal end, 7 in. (greatest), at the distal end, 8 in.

9. Megaptera bellicosa Cope. 1871.

Original description: Proceedings, American Philosophical Society, 12, 1873, pp. 103–107. Read October 21, 1870; published October (?), 1871.

Type-locality: Off the coast of Santo Domingo, Haiti, West Indies, or St. Bartholomew Island, West Indies.

Type-specimen: Skeleton of an individual 32 ft. long, forwarded to Philadelphia. Preserved in the museum of the Academy of Natural Sciences, Philadelphia.

The skull and other portions of the type-skeleton of *M. bellicosa* are figured on plates 29, 30, 31, 34, and 35.

This species was first described by Cope in 1871. It was based on a skeleton of an individual 32 feet long, obtained by Dr. A. Goës, colonial physician at St. Bartholomew Island, in the West Indies, either off Santo Domingo, Haiti, or at St. Bartholomew Island. Cope is not explicit on this point, but as Dr. Goës sent some parts of a Humpback skeleton to the Royal Museum, Stockholm, from St. Bartholomew Island in 1868, it is likely that the type of *M. bellicosa* was also from that locality (see *66*, 38). The skeleton was "forwarded to Philadelphia," but Cope does not state whether it went to the Academy of Natural Sciences, or not. At all events there is in the museum of the Academy a skeleton whose dimensions agree so closely with those given by Cope that there cannot be any reasonable doubt that it is the type of the species.

Cope's description of this species is rather fuller than in previous cases. He states that the skeleton lacks "the sternum, pelvic bones, and perhaps four caudal vertebræ. Of the latter, one is a large anterior vertebra, two are median, and one between the latter and the distal. The whole number thus restored will be Cerv. 7, D. 14, L. 10, Caud. 20; total, 51."

As regards the number of dorsal and lumbar vertebræ this skeleton shows no

difference from No. 21492, from Cape Cod, in the National Museum, while No. 16252, also from Cape Cod, has D. 14, L. 11, a difference of one lumbar. Some European specimens of *M. longimana* have 10 lumbars and others 11, while the number of dorsals remains constantly at 14.

Cope compares his *M. bellicosa* in many particulars with *M. longimana*, and also occasionally mentions *M. osphyia*. The differences which he finds between *M. bellicosa* and *M. longimana* are as follows:

(1) The whole form of the nasals is different in *bellicosa* and "at once distinguish it" from *longimana*.
(2) The ramus of the mandible is more slender in *bellicosa*.
(3) The elevated coronoid of *bellicosa* at once distinguishes it from *longimana*.
(4) The head bears a greater proportion to the length of the body in *bellicosa* than in *longimana*.
(5) The orbital plates of the frontal are less concave anteriorly in *bellicosa*.
(6) The first rib is broader (if Rudolphi's figures of *longimana* are correct).
(7) The pectoral fin is black externally in *bellicosa*, but " entirely white in Arctic *Megaptera*."

We will take up these differences in the order in which they appear above, considering them, however, as far as possible, in connection with specimens from the American side of the North Atlantic. As to whether these latter are identical with *M. longimana* has to be considered later.

The nasals of *M. bellicosa*, as described and figured by Cope, though they may differ from those of European specimens of *longimana*, are very similar to those of skeleton No. 21492 from Cape Cod, Mass. The chief difference is that in the latter specimen they are only very imperfectly serrated proximally for articulation with the frontal. The nasals of *bellicosa* seem long as compared with those of No. 21492, which is probably a skeleton of about equal size. They are 9 inches long in the former, $7\frac{3}{4}$ inches in the latter.

The importance of the slenderness of the ramus of the mandible in *bellicosa* I cannot estimate, as I have not seen that part of the skull. Cope's figures of the coronoid process indicate that that process is not larger than, or in any wise especially different from, the same part in the Cape Cod specimens.

The next point of difference mentioned by Cope is that in *bellicosa* the head is longer in proportion to the body than in *longimana*. He gives the length of the cranium in the former as 9 feet and the total estimated length of the skeleton, 31 feet 4 inches. This makes the skull 28.7 % of the total length. As the skull with the premaxillaries is undoubtedly some 6 inches longer, however, its proportion to the body would appear to be still greater. Skeleton No. 21492 from Cape Cod, Mass., is 33 ft. 10 in. long, and as it lacks probably the two final caudal vertebræ, about $7\frac{1}{2}$ inches should be added, making a total of 34 ft. $5\frac{1}{2}$ in. As the skull is but 9 ft. 5 in., its proportion to the body is but 27.3 %. It is to be observed, however, that in the type of *bellicosa* the scapula, axis, and humerus indicate an individual at least as large as No. 21492, and hence it is open to question whether

Cope's estimate of the total length may not have been considerably too small. At all events it is only an estimate, and hence this particular relation is not a good one to employ as an aid in determining the identity of the species.

In the skull of *bellicosa*, the anterior margin of the orbital plate of the frontal is nearly straight, as stated by Cope, and, hence, offers a contrast to other *Megaptera* skulls I have examined, in all of which the margin is quite concave.

In regard to the first rib of *bellicosa* Cope remarks: "If Rudolphi's figures [of *M. longimana*] are correct, the first rib is broader in the present animal, but the figure may be inaccurate." The width at the distal end in *bellicosa* is given as 7 inches. Struthers gives $7\frac{1}{8}$ inches for the right rib in his skeleton of *longimana*, and only 5 inches for the left rib. In skeleton No. 21492, both ribs of the first pair measure 5 inches at the distal end. It thus appears that there may be equality or marked inequality in the same individual, and hence the width of the rib, unless a considerable number of individuals can be compared, is not a character to be relied upon.

Finally, Cope states that the pectoral fin of *bellicosa* was black externally, but "entirely white in Arctic *Megaptera*." This is not, of course, from his own observation. The "Arctic *Megaptera*" Cope had in mind is doubtless *M. longimana*, but Cocks has shown (*17*) that in the Humpbacks killed at the Norwegian whaling-stations the color of the outside of the pectoral varies greatly. It may be entirely black, or only the proximal fourth black, or "black for only a very short distance at the proximal end," etc. Of three fresh specimens examined at Snook's Arm, Newfoundland, Aug., 1899, two (a male and a female) had the upper surface of the pectoral entirely white, except for a small area proximally, and a narrow posterior margin, where it was black. In the third specimen (a female), the proximal half was all black, and the distal half black and white mottled, the black predominant. There is, therefore, no constancy in the coloring of the pectoral, as, indeed, is the case also with the body, and the details of a single individual cannot be considered as having much importance.

It appears from the foregoing review that of the characters assigned by Cope to *M. bellicosa*, the shape of the anterior margin of the orbital process of the frontal is the only one which merits consideration. That this is not likely to be of importance seems probable from the fact that a further comparison of the type with specimens of the common Humpback of the Atlantic coast of North America, as detailed in a subsequent chapter, fails to disclose correlated distinguishing characters, while the agreement extends to many parts not mentioned by Cope. I feel justified, therefore, in treating *M. bellicosa* as representing the common Humpback and not a distinct species.

The following are actual measurements of the type-skeleton of *M. bellicosa*, according to Cope's system, made by me in 1900, to which are added Cope's original measurements:

MEGAPTERA BELLICOSA COPE. (TYPE.)

Measurement.	Cope's Measurements.	My Measurements. 1900.
	in.	in.
Total length of skull	108.	111.
Length of maxilla	65.	64.25[1]
" transverse, of orbital plate of frontal	29.	29.[2]
" longitudinal " " " "	26.	26.[3]
Distal width over orbit " " " "	11.5	11.5[4]
Length of nasals	9.	9.5[5]
Width " "	1.5	1.25[6]
" " cranium behind orbits (greatest)	64.	67.5
" " muzzle ½ the distance to frontal plates	27.5	26.25[7]
" " maxilla ¾ " " " " "	10.5	10.[8]
Length of mandible on curve	118.	—
First rib, on curve	37.	37.
" " distal width	7.	7.[9]
Humerus, length	21.	20.5[10]
Radius, "	30.	29.5[11]
Scapula, height	25.5	26.5[12]
" width	39.5	38.[12]
" glenoid length	11.5	11.
" " width	9.	9.

The following are actual measurements of the type-skeleton, made by me in accordance with the system I have applied to all the various species:

MEGAPTERA BELLICOSA COPE. (TYPE.)

SKULL—REGULAR MEASUREMENTS.

	Inches.
Length (straight)	114.5
Greatest breadth (squamosal)	67.5
Breadth of orbital process of frontal at distal end—least—point to point.	8.25
Length of rostrum (straight)	75.
Breadth of rostrum at middle (curved)	26.25[13]
Length of nasals	9.[12]
Breadth of nasals at distal end	8.[11]

SKELETON—REGULAR MEASUREMENTS.

	Inches.
Length of skull (straight)	111.
Greatest breadth of axis	21.5
Depth of centrum " " post.	7.
Depth of centrum " " ant.	6.[15]
Greatest breadth of 1st dorsal	19.5
Depth of centrum " " "	7.5
Greatest breadth of 1st lumbar	29.5
Depth of centrum " " "	8.
Greatest breadth of 1st caudal	26.[16]
Depth of centrum " " " anterior	10.
Greatest length of scapula	38.[12]
" depth " "	26.5[12]
Length of radius, along middle, with proximal epiphysis	—
" " " " " without epiphyses	29½[11]
" " ulna " " with proximal epiphysis	25.[11]
" " " " " without epiphyses	24.[11]

[1] The left maxilla. It is broken. About 3 in. should be added. [2] Along post-margin.
[3] Greatest, proximally. [4] Greatest; the least is 8½ in. [5] Left nasal; length of inner margin.
[6] Left nasal at proximal end. [7] As mounted. [8] Right. The left is 9½ in.
[9] The other rib, 1st pair, 7½ in. [10] Straight, when standing on its head, without distal epiphysis.
[11] Right. [12] Left. [13] As mounted. [14] Twice one.
[15] Median. The long diameter of the surface articulating with atlas is (right) 9 in.; (left) 8¾ in.
[16] Twice one half; the left diapophysis is defective.

SKELETON—EXTRA MEASUREMENTS.

	Inches.
Greatest breadth of atlas	20.5
" height " "	13.
" " " axis	13.5[1]
" breadth of 1st dorsal	19.5
" height " " "	14.5[2]
" breadth of 1st lumbar	29.5
" height " " "	22.[2]
" breadth of 1st caudal	26.[3]
" height " " "	23.5[1]

LENGTH OF TRANSVERSE PROCESSES OF CERVICALS.

Cervical No.	Superior.		Inferior.	
	Right.	Left.	Right.	Left.
	In.	In.	In.	In.
3.	(broken)	5	3	3
4.	$4\frac{3}{4}$	(broken)	$2\frac{1}{2}$	$2\frac{1}{2}$
5.	$5\frac{1}{2}$	$5\frac{1}{2}$	1	(none)
6.	$5\frac{3}{4}$	$5\frac{3}{4}$	(none)	(none)
7.	$5\frac{1}{2}$	$5\frac{1}{2}$	(none)	(none)

In the type-skull of *M. bellicosa* the anterior margin of the orbital plate of the frontal is nearly straight, as mentioned by Cope. The supraoccipitals are concave in the middle and bulbous on the sides, but the difference in this respect between this skull and No. 21492 U.S.N.M. from Cape Cod, Mass., is not great. There is a median ridge on the occipitals. The median inferior crest of the vomer terminates suddenly at the posterior end in *M. bellicosa*, while in No. 21492 U.S.N.M. it dies away gradually. The right nasal bone appears to have been lost. The left is preserved, and does not correspond with Cope's figures (all of which are very defective). It does agree with the nasals of skull No. 21492 U.S.N.M. The extreme length of the left nasal is $9\frac{1}{2}$ in.; breadth opposite the distal end of the inner margin, 4 in.; breadth of nasal orifice opposite extremity of outer margin of left nasal, $9\frac{1}{4}$ in.; depth of left nasal, $9\frac{1}{2}$ in.

The vertebræ preserved are cervicals, 17; dorsals, 14; lumbars, 10; caudals, 13; total, 44. The caudals missing are probably the 4th, 17th, 15th, 17th to 20th or 21st; in all 8 or 9, making a probable total for the skeleton of 52 or 53 vertebræ. The atlas has no distinct spine, but a crest about $\frac{1}{2}$ inch high. The total height of the 32d vertebra is $22\frac{1}{2}$ in., of which the neural arch and spine comprise $12\frac{1}{2}$ in. and the centrum 10 in. The scapula has a rudiment of a coracoid process, as in other specimens of *Megaptera*.

[1] Median.
[2] Posterior.
[3] Twice one half.
[4] Including process for chevron; posterior.

10. Megaptera versabilis Cope. 1869.

"The North Pacific Humpback."

Original description: Proceedings, Academy of Natural Sciences, Phila., 1869, p. 15. Presented for publication March 9, 1869; published July 20, 1869.

Type-locality: North Pacific.

No specimens. Named from Scammon's measurements and description.

The original description is as follows:

"The North Pacific hump-back. This species possesses pectoral fins, apparently intermediate in length between those of the *M. longimana* and the species with shorter fins, as *M. osphyia* and *M. kuzira*. They are between one-third and one-fourth the length; in the two last mentioned, between one-fourth and one-fifth. It has 26 pectoral and gular folds. Siebold states that the *M. kuzira* possesses but ten. In this animal the warts extend to the top of the front, a character not ascribed to any Atlantic *Megaptera*. It differs also from *M. longimana*, and resembles *M. lalandii* and *M. kuzira*, in having the pectoral black on the external face; in the Greenland species and in the model of the Aleutian Islanders, described by Chamisso, it is white. The characteristic color of the belly, in the most typical form, is said to be entirely black. In this respect it differs from all other *Megapteræ*, which present more or less white, or grey, on the inferior surfaces at least."

Note on Megaptera brasiliensis.

Though the locality of the specimen to which Cope attached this name takes it somewhat out of our range, I have thought it desirable to make reference to it here, in order that comparisons might be instituted, if necessary, between it and Cope's West Indian species, *M. bellicosa*, with which it might be supposed to be closely allied, if not identical.

From the brief statement in the *Proceedings* of the Philadelphia Academy of Natural Sciences, 1867, in which this name appears it might at first be supposed that Cope intended to describe a new species. His commentary on the paragraph in 1871, however, leads one to infer that such was not the case, though the matter is left in a very unsatisfactory condition. As both records are very brief, I will quote them in full. The paragraph of 1867 is as follows:

"Prof. Cope presented to the Academy a young specimen of the whale, known as the Bahia Finner, procured near Bahia, Brazil, the length of which was 21 feet. He said it belonged to the genus *Megaptera*, Gray, with the hunchback whales of sailors. The evidence consists in the very short di- and parapophyses of the cervical vertebræ and the absence of all trace of acromion and coracoid processes. The orbital processes of the frontal are narrowed externally and the muzzle considerably narrowed. Judging from the name, it possesses a more fully developed dorsal fin than the other *Megaptera*. It should be called *Megaptera braziliensis*." (*25*, 32.)

Cope's commentary on this, published in 1871, is as follows:

"The species described by Gray (Catal. B. Mus., 1866, 62) as *Physalus brasiliensis*, founded on some baleen of the 'Bahia Finner,' has been supposed by me

(Proc. A. N. Sci., Phila., 1867, p. 32) to be a *Megaptera*. Certain it is that a *Megaptera* is found at Bahia, as I have seen larger and smaller portions of two skeletons of one, but whether it be the 'Bahia Finner' and *P. brasiliensis*, Gray, is quite doubtful. In the first place, fishermen and whalers never call a 'hump-back' (*Megaptera*) a 'finner'; if they have done so in the case of this species, it evidently has a noticeable dorsal fin, which is wanting in the present whale. In the next place, baleen of the 'Bahia Finner' has a commercial value, being exported to England, while that of *Megaptera* has none, being coarse and twisted." (*29*, 107.)

From a comparison of these two paragraphs it would appear that Cope first brought forward his specimen as indicating that Gray's *Balænoptera brasiliensis*, or "Bahia Finner," was a *Megaptera*, but afterwards concluded that though a *Megaptera* unquestionably occurred in the vicinity of Bahia, it was "quite doubtful" whether the same was Gray's *B. brasiliensis* after all. We may properly consider that Cope's remark that "it should be called *Megaptera brasiliensis*" means merely that when he first wrote, in 1867, he thought Gray's *Balænoptera brasiliensis* should be transferred to the genus *Megaptera*. The *Megaptera brasiliensis* is not, therefore, to be considered as one of Cope's new species, and the skeleton which he presented to the Philadelphia Academy is not a type. Disposed of in this way, as I believe it should be, there is still a matter of interest in determining what the skeleton was which Cope presented to the Academy.

So little is left of the specimen and it is so young, that it is hardly worth consideration. The skull is very immature and lacks the right maxilla. The spines and processes of the vertebræ are all separate, showing immaturity. I have found 37 vertebræ in all, apparently without the atlas and axis, and numerous caudals are doubtless lacking.

The skull, so far as can be judged, does not differ notably from that of *M. bellicosa*. The breadth across the squamosals (greatest) is 38 in.; the orbit, point to point, 6 in. What Cope means by saying that the "orbital processes of the frontal are narrowed externally," is not evident. The orbits are very large relatively, as is to be expected in so immature an individual. Length of mandible, straight, 5 ft. 1½ in.; curved, 5 ft. 5 in.

There are 14 pairs of ribs, all very fragile. The first is broad distally, as in *M. bellicosa*. Measurements of the limbs are as follows:

Scapula:	Breadth, 1 ft. 10 in.	
	Height, 1 " 3½ "	
Humerus:	Length, 0 " 9½ "	without epiphyses (straight).
Radius:	Length, 1 " 8¾ "	" " " "
Ulna:	Length, 1 " 5½ "	" " " "

The total length of the skull (as well as can be made out) is 5 ft. 2 in. Length of rostrum, 3 ft. 2½ in. Breadth of rostrum at middle, estimated, 14 in. Depth of mandible at middle, 6½ in. Nasals are lacking.

Note on Agaphelus gibbosus (Erxleben) Cope.

The first mention of this whale by Cope is in the *Proceedings* of the Academy of Natural Sciences, Philadelphia, 1867, p. 147, where he says in a foot-note:

"A fine specimen of this species [*Balænoptera rostrata*], over 30 feet long, went ashore during the autumn of 1866, on the Long Beach, N. J. It was much injured, probably by the killers. This species has not been before noticed on our coasts."

It is evident that he thought the whale to be *B. acuto-rostrata* at this time, but in the same *Proceedings*, 1868, p. 159, he is quoted as making the following statement on June 23d, 1868:

"He [Prof. Cope] mentioned that he had opportunity of examining a portion of a specimen of the Scrag Whale of Dudley, *Balæna gibbosa* of Erxleben, and ascertained that it represented a genus not previously known. It was a fin-back whale, but without dorsal fin or throat folds, resembling superficially the genus *Balæna*. The baleen short and curved. The genus was called *Agaphelus*.

"A second species of the genus was to be found in the 'gray whale' of the coasts of California. The baleen of this species, compared with that of the *A. gibbosus*, was longer and had narrower basis. The plates moderately and simply concave, while those of the latter are sigmoidal, most curved near the outer margin in cross section. The bristles of the California species were very coarse, varying from one to three series between the enamel plates. The bristles of the *A. gibbosus* much finer, three series together. Length of the latter, 8.5 inches, width at base, 4.4 inches. In the gray whale or *Agaphelus glaucus* Cope, 22 inches in length, width at base 6 inches. In the former nearly 6 in an inch, in the latter 2½. The baleen of the *A. gibbosus* belonged to an immature specimen of 35 feet in length."

I understand this to be the specimen that Cope referred to in 1867 under the name of *B. rostrata*, as appears from the same *Proceedings*, 1868, p. 224, where he cites that reference in synonymy. He now calls it *Agaphelus gibbosus* Cope, and gives the estimated length of the specimen, which was young, as 43 feet.

At the beginning of this article, on p. 221, he makes the following statement:

"During the autumn of 1866 a whale was cast ashore on the Long Beach, Ocean Co., N. J., opposite Westecunk, on the other side of Little Egg Harbor, near the residence of Wm. A. Crane. A recent visit to the spot furnished me with the means of determining the species to which this monster of the deep belonged, although not with the completeness desirable, as the tide had a short time previously taken off the most bulky part of the carcass. Thus the cranium, cervical and dorsal vertebræ, with the first ribs, the most important portions for its identification, were lost. There were preserved, however, the mandibular arch, ear-bone, one scapula and both fins, numerous ribs, many lumbar and caudal vertebræ, with the baleen from one side of the maxilla. These portions, with a few prominent points dependent on the observations of Wm. A. Crane, serve to indicate a species not only new to our fauna, but new to modern science. The evidence of my informant, as that of an old and experienced coaster and waterman, and one familiar with the appearance of our cetaceans, confirmed by his sons and by the specimens preserved, so far as they went I consider reliable. . . .

"In general features this Cetacean seems to be an intermediate form of the toothless whales; and an additional feature, which depends on the observation of my friend W. Crane, and in which I cannot conceive it possible that he should be mistaken, indicates still more conclusively that it pertains to a genus not before characterized. The whale was first driven on shore on its back, and the gular and

thoracic regions were seen to be entirely without ridges or plicæ of any kind, but as smooth as any other part of the body, or as the throat of a right whale, *Balæna cisarctica* Cope, which is not uncommon on the same coast."

At the end of description, on page 225, he remarks:

"The owner of the whale tried out about one-fourth of the blubber, and procured sixty-five gallons of oil, which would give about four hundred gallons for the whole; the thickness of the adipose layer would not average 4 inches, the greatest thickness was 5 inches.

"This species was black above and white below, the sides lead-colored, with longitudinal shades of the darker color; fins, basal half white, terminal black."

The genus and species are again commented upon by Cope in the same *Proceedings*, 1869, pages 14–15, and were subsequently mentioned and discussed by various authors and still appear in current lists of cetaceans. In 1884, however, in commenting in the *American Naturalist*, 18, p. 1123, on my list of cetaceans for the London Fisheries Exhibition, Cope remarks:

"The *Agaphelus gibbosus* must be withdrawn from the list of authentic species. The bones which I referred to it are probably those of *Balænoptera rostrata*. The characters of the animal in the flesh were given me by persons whom I supposed to be trustworthy, but who may have been mistaken. The species may, however, be the *Balæna gibbosa* of the old authors."

From the evidence it seems extremely probable that Cope was right in coming back to his original view that the specimen was one of *B. rostrata*. The color of the whalebone and of the pectoral fin would especially seem to indicate that species; and the misstatement regarding the length of the animal, etc., may be explained on the ground that Cope examined only a portion of the skeleton. The chief circumstance which led him to erect the genus *Agaphelus* seems to have been that the fishermen who found the specimen on the beach affirmed that the throat was without folds and that there was no fin on the back. The statements regarding these parts appear to have been made to Cope about two years after the animal was observed and there was abundant time for the real facts to have been forgotten.

The matter was complicated by two other circumstances: First, that the fishermen have long recognized a whale called the Scrag whale, which is said to have the same characters which Cope's specimen was supposed to have; and, second, that Cope at this time became acquainted with the fact that there was a whale on the Pacific coast which had the smooth throat and back, namely, the Gray whale (*Rhachianectes*). The existence of this whale on the Pacific coast made it probable that a similar species might be looked for on the Atlantic coast.

In 1869, as already stated, Cope established the genus *Rhachianectes* (*83*, 15) for the California Gray whale, thus leaving the supposed Atlantic "Scrag whale" as the only representative of the genus *Agaphelus*. As the latter was founded on a *Balænoptera*, the generic name *Agaphelus* should be expunged from the literature.

Cope states, as noted above (*26*, 221), that the mandibular arch, an ear-bone, one scapula, both fins, numerous ribs, many lumbar and caudal vertebræ, and the baleen from one side of the maxilla were preserved. The whereabouts of this material could not be ascertained. It does not appear to be in the Philadelphia Academy. Cope (*26*, 221) gives measurements of some of the parts, which may be compared with Turner's Granton (Scotland) specimen (*92*, 68), as follows:

Measurement.	*Balænoptera acuto-rostrata*. Granton, Scotland.	"*Agaphelus gibbosus*."
Length of mandibular ramus (in curve).....	6 ft. 4½ in.	6 ft. 0 in.
Depth of mandible at coronoid.....	9 in.	8½ in.
Length of the humerus.....	11½ in.	11½ in.
" " " radius and ulna.....	(nearly) 18 in.[1]	17 in.

This correspondence of Cope's specimen with a well-authenticated *B. acuto-rostrata* is very interesting.

[1] Ulna.

CHAPTER IV.

THE COMMON FINBACK, *BALÆNOPTERA PHYSALUS* (LINN.).

This species is the "Common Finback" of European waters. Hundreds of individuals have been taken at the Finmark whaling stations since 1874, and scores have been recorded as stranding at various points on the coasts of Europe during the 18th and 19th centuries. The species has been, on this account, more carefully studied than any other Finback. Sars's diagnosis of the species, published in 1878 (*79*, 17), is as follows:

"Length of full grown individuals reaching to 70 feet.

"Body slender; the greatest height scarcely exceeding $\frac{1}{6}$ the length; behind the navel very much attenuated, the posterior half very narrow and maintaining almost the same depth throughout.

"Color above and on the left side of the lower jaw dark gray, below white; color of the back descending obliquely behind the pectoral fins so as to leave only a narrow median longitudinal area (below) along the posterior part of the body.

"Mouth equalling about $\frac{1}{5}$ the length of the body; upper jaw seen from above very narrow, wedge shaped, gradually decreasing in width toward the apex.

"Pectoral fins small, scarcely exceeding $\frac{1}{9}$ the length of the body, narrowly lanceolate, with the posterior angle often but little distinct; the external surface showing the color of the back, the internal surface and the whole anterior margin, white.

"Dorsal fin quite high, triangular, with the scarcely curved apex directed obliquely backward; situated behind a vertical line drawn through the anal orifice.

"Caudal fin uniformly white below, with the margins dusky.

"Whalebone dull bluish, varied with lighter color; some near the apex [of the upper jaw] white."

The admirable figure accompanying Sars's article (plate 2) agrees exactly with the diagnosis. It represents the *right* side of the whale, showing the lower jaw and the anterior whalebone white, a character of importance, as will appear later. Sars's diagnosis in Norwegian is somewhat fuller than that in Latin, which is translated above, and may be profitably included here:

"Length of full-grown individuals reaches to 70 feet.

"Body of especially slender and attenuated form, with the greatest height never exceeding $\frac{1}{6}$ the total length, back of the navel suddenly and strongly diminishing, so that the whole of the posterior portion of the body becomes unusually small and almost everywhere of one height as far as the root of the flukes.

"Color above and also on the left side of the under jaw quite light gray, brownish, or passing into sepia color. The color of the back, as in the Little Piked whale, descends obliquely from the pectoral fins across the sides of the body, and on the part lying behind the vent there is only a very narrow and sharply defined white stripe along the ventral side.

"The length of the mouth is about equal to $\frac{1}{5}$ the total length, and the upper jaw seen from above is quite narrow, conical, or uniformly decreasing in breadth toward the tip.

"The pectoral fins are very small, scarcely exceeding $\frac{1}{9}$ the total length, narrow, lanceolate, with the posterior angle unusually little prominent. On its outer side showing the color of the back, but the inner side and the whole of the anterior border pure white.

"Dorsal fin proportionally rather high (at least in males) and of a triangular form, with the tip not strongly curved, and directed obliquely backward. It lies rather far back, immediately behind a vertical line drawn through the anus.

"Flukes, pure white on the lower surface, with dark margins.

"Whalebone, dark bluish and somewhat variegated, but with the exception that some of the most anterior of it is yellowish white as in the Little Piked whale."

In preparing for my first trip to the Newfoundland fishery at Snook's Arm, I brought together in abstract form all the principal external characters assigned to this species by the more recent European authorities, and for convenience of reference they are given in brief form below:

Average total length.

81 males = 62 ft. 7 in. (Cocks, from whalers.)
105 females = 64 ft. 1½ in. (Cocks, from whalers.)

Mean total length.

60 to 70 ft. (Guldberg.)

Maximum total length.

Male, 72 ft. 1 in. (Cocks.)
Female ("bastard"), 80 ft. 6 in. (Cocks.)

Proportion of length of jaws to total length (average.)

20.8 per cent. (F. W. T., compiled.)
(Length of mouth from tip of lower jaw = $\frac{1}{5}$ the total length = 20 per cent. Sars.)
Variation: Length of mouth = 19.5 to 22.5 per cent. (F. W. T., compiled.)

Proportion of length of pectoral (from axilla) to total length (average).

10.5 per cent. (F. W. T., compiled.)
$\frac{1}{10}$ to $\frac{1}{9}$ = 10 per cent. to 11 per cent. (Guldberg.)
$\frac{1}{9}$ = 11.1 per cent. (Sars.)
Variation: 9.9 to 11.3 per cent. (F. W. T., compiled.)
(Flower gives 8.7 per cent. for the Portsmouth, England, specimen, 1869.)

Proportion of length of pectoral from head of humerus to total length (average).

12.4 per cent. (F. W. T., compiled.)

Variation: 11.8 to 13.3 per cent. (F. W. T., compiled.)

Percentage of total length anterior to the posterior margin of the dorsal fin (average).

75 per cent. (F. W. T., compiled.)

(The larger part of the dorsal lies behind a vertical line drawn through the vent. SARS.)

Variation: 72.9 per cent. to 77.7 per cent. (F. W. T., compiled.)

Proportion of vertical height of dorsal to total length (average).

2.3 per cent. (F. W. T., compiled.)

Variation: 2.0 to 3.5 per cent. (F. W. T., compiled.)

(RAVIN gives 1.4 per cent. in one case.)

Shape of pectoral fins.

Anterior edge thick, posterior edge thin.

Pectorals narrowly lanceolate, with the posterior angle generally but little pronounced. (SARS.)

Color above (normal).

Blackish, or gray-black. (COCKS.)

Light brown-gray, or approaching sepia-color. (SARS.)

Right lower lip white, left dark.

Dark color extends obliquely down from behind the pectorals, leaving only a narrow white stripe below. (SARS.)

Variation: Black when some time dead. (MURIE, RAVIN, etc.)

Gray-blue. (COCKS.)

SARS's Lofoten specimen had an irregular light patch between the root of the pectoral and the corner of the mouth.

Color below (normal).

White throughout.

"With a grayish band passing over it." (GULDBERG.)

Variation: Tinged with yellowish, especially in oldish individuals. (GULDBERG).

In a dead whale the posterior 12 feet of the "small," or caudal peduncle, gray black. (COCKS.)

Yellowish white. (MURIE. Specimen some time dead.)

Markings.

Jaw and chin white, with black flecks.

Variation: Left upper and lower lips jet-black. Right lips enamel-, or milk-white. (COCKS. Dead whales.)

Color of upper surface of pectorals (normal).

Light slate-color, tipped with white at extreme distal edge. (Cocks.)

Same dark color as the back. (Sars.)

Variation: "Blue, with almost a brownish tinge at the proximal end." (Cocks, "Hybrid Whale.")

Dingy black. (Murie. Specimen some time dead.)

Color of lower surface of pectorals (normal).

White.

Lower surface and whole anterior margin white. (Sars.)

Variation: White running over the anterior margin, and the gray of the upper surface overspreading the under surface posteriorly and proximally. (Cocks.)

Whitish. (Murie. Specimen some time dead.)

Color of upper surface of flukes (normal).

Dull black. (Cocks.)

Color of lower surface of flukes (normal).

White.

Pure white; with sharply defined dark margin. (Sars.)

Variation: Shading through streaks of gray to a little white about the center of each lobe. (Cocks.)

Average length of longest baleen, without bristles.

Less than 3 feet. (Guldberg.)

30 inches. (Murie.)

Mean number of plates of baleen on one side.

360. (Murie.)

Color of baleen plates (normal).

Black on the outer edge, then slate, gradually striping to yellow on the inner margin. (Cocks.)

Blue-gray, with light stripes. (Guldberg.)

Foremost blades yellow, or grayish white. (Guldberg.)

(In Ravin's specimen the anterior third of the series all whitish, the remainder all slate-gray; the transition abrupt.)

Color of bristles of baleen (normal).

Yellow, almost buff. (Cocks.)

It has been recognized for a long time that a species closely resembling *B. physalus*, if not identical with it, occurs on the east coast of America, from Green-

land southward. For many years it formed the object of a more or less irregular fishery in Massachusetts Bay, and considerable numbers of individuals have stranded at various points on the coast, the skeletons of some of which have been preserved in the museums of the United States. One of these skeletons was described by Dwight in 1872 (*35*), and we have endeavored to show that the type of Cope's *B. tectirostris* also belonged to this "Common Finback" of American waters (see p. 87).

In 1899, having learned that a whaling company, known as the Cabot Steam Whaling Company, was engaged in fishing for Finbacks on the east coast of Newfoundland, I obtained the permission of the Secretary of the Smithsonian Institution to visit the island for the purpose of making observations on the various species captured. Through the kindness of Messrs. Harvey & Co., of St. John's, Newfoundland, agents of the whaling company, I was given every facility for the study of the whales taken in Notre Dame Bay and brought into their station at Snook's Arm in that bay to be stripped of blubber and whalebone. I remained at the station three weeks, and examined with considerable care 25 whales which were brought in. The capture of the whales was prosecuted in the same manner as on the Norwegian coast, and indeed a large proportion of the stockholders in the company were Norwegians, the steamer used in pursuing the whales was built in Norway, and the captain and a majority of the crew were Norwegians. Through the courtesy of Captain Bull, who was in command of the steamer *Cabot*, I was permitted on several occasions to witness the chase from a favorable station on the bow of the boat, where I could observe the motions of the whales in the water, the effect of the bomb-harpoons, and the *modus operandi* of securing the dead whales to the steamer's side and towing them to the station. Capt. Bull did everything in his power to assist me in my work, and gave me much valuable information concerning whales in American, Norwegian, and Japanese waters, from his own observations.

An important part of the works at the Snook's Arm station was a large inclined platform, or slip, upon which the whales were drawn up, one at a time, completely out of the water, thus affording excellent opportunities for close inspection.

I soon ascertained that all the whales taken at this station were of two kinds, a Finback and a Humpback. The Finback was much the more abundant at the time of my visit, in August, but I was informed by Capt. Bull that the Humpback arrived in large numbers later in the year. A Finback was already in the slip at the time of my arrival at the station, and I was not long in determining that I had to do with a species closely allied to, or identical with, *Balænoptera physalus*. As each individual was drawn up on the slip, I measured it, using a uniform schedule of measurements, and photographed it from one or more points of view, and made as copious notes as circumstances would permit on its color and other characters. As the whaling crew was eager to cut up the whales the moment they were drawn out on the slip, observations had to be made with all celerity, especially as the men, by aid of a steam winch, stripped off the skin and blubber in an incredibly short

time, and when they had removed it and the whalebone, slid the carcass into the water again at once. In spite of these circumstances, I was able to make valuable observations on the external characters of the species and on individual variation. The skeletons, however, were not available for study.

As the result of my observations of this Finback, I ascertained the following general facts:

(1) That the individuals captured varied considerably in size.

(2) That both sexes were obtained, and that the females predominated.

(3) That the females were in different stages and conditions as regards gestation.

(4) That the color of the body was subject to considerable variation in different individuals.

(5) That the coloration of the two sides of the body was asymmetrical, as in *B. physalus.*

(6) That some individuals had a large amount of food in the stomach, while others had little, or none.

SIZE.

The total length and the sex of the several individuals examined are shown in the following table:

BALÆNOPTERA PHYSALUS (L.). SNOOK'S ARM, NEWFOUNDLAND.

Capture Number.	Date of Capture.	Sex.	Total Length.
(1) No. 1	Aug. 4	♂	55 ft. 2 in.
(2) " 2	" 5	♀	63 " 4 "
(3) " 3	" 8	♀	63 " 7 "
(4) " 4	" 8	♀	61 " 10 "
(5) " 7	" 10	♀	50 " 7 "
(6) " 8	" 10	♀	57 " 6 "
(7) " 9	" 11	♀	59 " 1 "
(8) " 10	" 11	♂	53 " 9 "
(9) " 11	" 11	♀	70 " 8 "
(10) " 12	" 12	♂	54 " 6 "
(11) " 13	" 12	♀	61 " 2 "
(12) " 14	" 15	♀	67 " 0 "
(13) " 15	" 15	♂	62 " 10 "
(14) " 16	" 15	♀	63 " 9 "
(15) " 17	" 16	♂	65 " 0 "
(16) " 18	" 17	♀	62 " 0 "
(17) " 19	" 18	♀	62 " 11 "
(18) " 20	" 18	♀	62 " 8 "
(19) " 22	" 18	♂	56 " 1 "
(20) " 23	" 21	♀	66 " 7 "
(21) " 24	" 22	♀	62 " 9 "
(22) " 25	" 22	♂	59 " 10 "
(23) " 26	" 22	♂	59 " 0 "
(24) " 27	" 22	♀	65 " 3 "
(25) " 28	" 22	♀	54 " 0 "

The males and females in order of size were as follows:

BALÆNOPTERA PHYSALUS (L.). SNOOK'S ARM, NEWFOUNDLAND.

Males.		Females.	
65 ft. 0 in.	59 ft. 0 in.	*70 ft. 8 in.	62 ft. 9 in.
62 " 10 "	56 " 1 "	*67 " 0 "	*62 " 8 "
61 " 2 "	55 " 2 "	*66 " 7 "	62 " 0 "
59 " 10 "	54 " 6 "	*65 " 3 "	*61 " 10 "
59 " 1 "	53 " 9 "	*63 " 9 "	57 " 6 "
		*63 " 7 "	54 " 0 "
		*63 " 4 "	50 " 7 "
		*62 " 11 "	
Maximum.....	65 ft. 0 in.		70 ft. 8 in.
Minimum.....	53 " 9 "		50 " 7 "
Average.....(10)	58 " $7\frac{7}{10}$ "		(15) 62 " $3\frac{1}{2}$ "

Statistics of Norwegian *B. physalus*, compiled from Cocks's observations, as already seen (p. 108), are as follows:

BALÆNOPTERA PHYSALUS (L.). NORWAY.

Males.	Females.
Maximum..... 72 ft. 1 in.	80 ft. 6 in. ("Bastard")
Average.....(81) 62 " 7 "	(105) 64 " $1\frac{1}{2}$ "

The Norwegian *B. physalus* appears, therefore, to be larger than the individuals taken at Snook's Arm.

As regards the maxima, it should be observed that Cocks's figures are derived from a much larger number of individuals than mine, and the same is true as regards the averages. Cocks obtained the figures on which the averages are taken from the whalers and not from measurements made by himself.

As regards minima, it should be kept in mind that the whalers at Snook's Arm avoided the smaller individuals since they were unprofitable for oil. There were undoubtedly many small, young whales in Notre Dame Bay at the time the larger ones above cited were obtained. They were distinguishable in the water and their spout was less dense and high than that of the adult.

The females in the foregoing table marked thus (*) contained fœtuses, or were accompanied by young. Those of which I recorded the length of the fœtus were as follows:

BALÆNOPTERA PHYSALUS (L.). SNOOK'S ARM, NEWFOUNDLAND. FŒTUSES.

Capture No.	Date.	Length of Adult.	Length of Fœtus.	Sex of Fœtus.
No. 2	Aug. 5	63 ft. 4 in.	6 ft. 5 in.	♂
" 3	" 8	63 " 7 "	12 " 9 "	♀
" 14	" 15	67 " 0 "	15 " 2 "	♂
" 16	" "	63 " 9 "	12 " 8 "	—
" 19	" 18	62 " 11 "	6 " 9 "	♂
" 20	" "	62 " 8 "	11 " 4 "	—
" 27	" 22	65 " 3 "	6 " $10\frac{1}{2}$ "	♀

Three fœtuses found on the days immediately preceding my arrival at the station were as follows:

Date.	*Length.*	*Sex.*
Aug. 3	7 ft. 11 in.	♀
" "	9 " 0 "	♂
" 4	6 " 11 "	♂

The smallest sexually-mature female taken at Snook's Arm in 1899, as indicated by the presence of a fœtus, or of milk flowing from the mammæ, was 61 ft. 10 in. long, but as there is an interval of 4 ft. 4 in. between this length and the length of the largest female without fœtus (57 ft. 6 in.), it may be supposed that the real minimum of maturity is somewhat less than as above given. That this is quite surely true is indicated by the measurements of total length obtained by Cocks from the Norwegian whalers (*18*, 9 sep.). Cocks cites 25 females as containing fœtuses. These varied in length from 76 ft. 3 in. to 55 ft. 7 in.,[1] the latter, therefore, representing the minimum.

The next largest specimen containing a fœtus was 57 ft. 8 in. long.[2] The mean length of the 25 specimens was between 67 ft. and 68 ft. and the average length 65 ft. 11 in.[3]

Revising the calculation of average length of females at Snook's Arm, by throwing out the two respectively 54 ft. and 50 ft. 7 in. long, as most certainly immature, we have 63 ft. 10 in. as the average for mature females.

A second station of the Cabot Steam Whaling Company was established in the fall of 1899 on the south coast of Newfoundland in an arm of Hermitage Bay, recently named McCallum Bay. The station received the name of Balena. The records of this station, which were kindly placed at my disposal, show that 15 Common Finbacks (all males but one) were taken there during the year 1900, and 11 during the year 1901, to July 3d. Adding these 26 specimens to the 25 measured at Snook's Arm in 1899, the average total length for the whole 51 specimens of both sexes is 59 ft. $1\frac{7}{10}$ in.[4]

These various calculations are brought together on page 115 for comparison.

[1] 74 to 54 feet, Norwegian.

[2] 56 feet, Norwegian.

[3] The following are measurements of females stranded on the European coast, which according to the records contained fœtuses:

Date.	*Locality.*	*Length.*	*Authority.*
1878	Monte Rosso, Italy	22 m.	Van Beneden
1879	Groix Id., France	20.8 m.	Pouchet
1859	Port Vendres "	20 m.	Van Beneden
1863	Cape Creux, Spain	19.5 m.	" "

The smallest of these, $19\frac{1}{2}$ metres, or 63 ft. $11\frac{7}{10}$ in., is considerably larger than the Snook's Arm minimum.

Out of 110 records of strandings on the coasts of Europe, which I have collected, the four cited above are the only ones in which the presence of a fœtus is noted.

[4] The average total length of the 14 males taken at Balena station in 1900 was 55 feet $7\frac{7}{10}$ in. The length of the single female was 59 feet. The sex of the specimens taken in 1901 was not recorded.

BALÆNOPTERA PHYSALUS (L.). AMERICAN AND EUROPEAN.

Locality.	Average for all specimens of both sexes.		Average for all females.		Average for all males.		Average for mature females.[1]		Average for mature males.[1]		Maximum for females.[5]	Maximum for males.	Minimum for females.	Minimum for males.
	No.	Length.	No.	Length.	No.	Length.	No.	Length.	No.	Length.	Length.	Length.	Length.	Length.
Newfoundland:														
Snook's Arm, 1899.	25	60′ $10\frac{3}{32}$″	15	62′ $3\frac{1}{2}$″	10	58′ $7\frac{7}{10}$″	13	63′ 10″	7	60′ 5″	70′ 8″	65′ 0″	50′ 7″	53′ 9″
Balena, 1900.	15	55′ $10\frac{3}{32}$″	...	.....	14	55′ $7\frac{7}{10}$″	..	.....	..	.....	.....	64′ –	.....	44′ –
" 1901.	11	59′ $7\frac{3}{32}$″	...	.....	...	.....	..	.....	..	.....	(64′, sex unknown)		(48′, sex unk'n)	
All the foregoing Newfoundland specimens.	51	59′ $1\frac{7}{10}$″	...	.....	...	.....	..	.....	..	.....	70′ 8″	65′ 0″	50′ 7″	44′ –
Norway (Cocks).	186	63′ $5\frac{1}{2}$″	105	64′ $1\frac{1}{2}$″	81	62′ 7″	25	65′ 11″	74	66′ 7″	80′ 6″	72′ 1″	41′ 2″	43′ 0″
Europe generally (stranded, or captured on the coasts).	53[2]	57′ $5\frac{6}{10}$″	14[2]	57′ $11\frac{1}{10}$″	17[2]	62′ $6\frac{4}{10}$″	8	66′ $8\frac{1}{5}$″	14	65′ $9\frac{3}{10}$″	72′ $1\frac{9}{10}$″[3] (22 m.)	83′ $11\frac{6}{10}$″[4] (25.6 m.)	.....	.....

It appears from this table that both the maximum and the average total length of mature individuals of both sexes from Newfoundland waters are considerably less than for European specimens. The close approximation of the averages for mature individuals of both sexes, based on Cocks's observations at the Norwegian fisheries, with those for the various specimens stranded or captured at other points on the European coast is of much interest. Further, the table shows, as might be anticipated, that averages which include many immature individuals are very unreliable. The reason why the average for female European specimens of all ages is so much below that for the males is simply that the collected records on which the averages are based include many more immature females than males.

PROPORTIONS.

In comparing proportions it is desirable, in order to avoid misinterpretation, to select measurements which different observers are likely to take from the same points and in the same manner. The following are among the best: Total length,[6] tip of snout to eye, *ditto* to posterior margin of dorsal fin, breadth of flukes from tip to tip, notch of flukes to anus, *ditto* to navel. Such measurements as "length of base of dorsal fin" are of little value, as the fin rises from the back in a very gradual curve, and it is impossible to fix on any point of origin. Even the measurement of the length of the pectoral fin, though so important, is uncertain. It may be taken from either the anterior or the posterior insertion (both points of indefinite location) or from the head of the humerus. The latter is alone satisfactory.

In measuring a considerable number of whales it will be found impossible to follow any system rigorously or completely, as the different individuals cannot be turned about and handled at will, as in the case of small animals. In the following table a large variety of measurements is included, many of which are taken from but a single specimen. From this series will be selected such as are suitable for comparison with measurements of European specimens:

[1] Specimens 55′ 7″ long and over. [2] Everything below 41′ 8″ thrown out to agree with other general averages.
[3] Monte Rosso, Italy, Oct., 1878. [4] St. Cyprien, France, Nov. 27, 1828.
[5] A specimen stranded in 1879 at Soulac in an advanced state of decomposition, and variously estimated as 27 m., 24 m., and 85 or 90 ft. long, is cited by Fischer (*Cét. S. O. France*, 1881, p. 70) as belonging to this species. Also one at Dunquerque, 1863, 30 m. long, and the Ostend specimen, more than 30 m. long. The latter is certainly *B. musculus*, and Van Beneden is doubtless correct in including the others also under that species. [6] See p. 4.

BALÆNOPTERA PHYSALUS (L.). NEWFOUNDLAND.

Measurement.	Snook's Arm, 1899.													Balena, 1901.
	No. 1, Aug. 4. ♂	No. 2, Aug. 5. ♀	No. 3, Aug. 8. ♀	No. 4, Aug. 8. ♀	No. 7, Aug. 10. ♀	No. 8, Aug. 10. ♀	No. 9, Aug. 11. ♂	No. 10, Aug. 11. ♂	No. 11, Aug. 11. ♀	No. 12, Aug. 12. ♂	No. 13, Aug. 12. ♂	No. 19, Aug. 18. ♀	No. 20, Aug. 18. ♀	No. 16, July 2. ♀
Total length, tip of snout to notch of flukes	55′ 2″	63′ 4″	63′ 7″	61′ 10″	50′ 7″	57′ 6″	59′ 1″	53′ 9″	70′ 8″	54′ 6″	61′ 2″	62′ 11″	62′ 8″	60′ 11″
Circumference opposite tip of pectoral (laid back)	in.	in.	in.	in.	in.	in.	in.	in.	in. ...	in. 304[1]	in. 352[1]	in.	in.	in. .....
Tip of snout to eye	....	164	156	163	120	139	137	133	169	128	150½	149	162	151
" " " " blowhole (center)	123	138	140	139	107	....	122	120	154	123	135	.....	148	134
" " " " head of humerus	....	....	222	240	....	....	205	....	....	....	....	.....	....	.....
" " " " ant. insertion of pectoral	....	....	....	.....	....	204	...	....	....	....	....	.....	....	.....
Tip of snout to post. insertion of pectoral	....	....	....	.....	....	....	230	219	285	219	244	244	260	244
Tip of snout to ant. base of dorsal fin	484	559	552	562	....	492	509	456	598	468	526	.....	542	.....
Tip of snout to post. base of dorsal fin	....	....	588	593	458	535	548	499	642	504	570	.....	576	552
Notch of flukes to anus	....	198	208	192	180	192	204	197[2]	242	185[2]	204	221	220	209
" " " " orifice of vagina		222	233	219	200	....	....	....	....	....	....	243	...	.....
" " " " clitoris	....	....	....	.....	...	213	. ..	....	269	....	....	.....	242	230
" " " " mammary slit	....	221	....	.....	....	....	....	....	....	....	....	.....	....	.....
" " " " center of orifice of penis	....	....	....	.....	....	....	....	240	....	....	261	.....	....	.....
Notch of flukes to base of penis	....	....	....	....	....	....	261	....	....	233[2]	....	.....	....	.....
" " " " navel	....	....	....	.....	....	306	331	312[2]	382	290[2]	319	362	354	.....
" " " " post. ? insertion of pectoral	....	...	526	.....	444	....	....	....	....	....	....	.....	....	.....
Notch of flukes to head of humerus	....	....	540	.....	450	....	....	....	....	....	....	.....	....	.....
Length of pectoral, from tip to head of humerus	86	98½	88	91½	79⅛	83	....	72	106	80	88	92	96	89
Length of pectoral, from tip to post. insertion	....	...	....	58½	....	56	59	57	72	56	60	65	66	53
Greatest breadth of pectoral	32?	23	20	20	18½	20	20	20	24	20	23	24	23	21
Head of humerus to post. insertion of pectoral	....	....	34	.....	...	....	....	....	....	...	....	.....	....	.....
Head of humerus to ant. insertion of pectoral	....	....	11	.....	....	....	....	....	....	....	....	.....	....	.....
Height of dorsal (vertical)	....	20	17½	20	16	19	14	....	21	....	18⅛	24	16	16
Length of dorsal (longitudinal)	....	45	....	.....	33	38	....	....	....	....	....	.....	....	.....
Antero-post. breadth of flukes, from ant. insertion to post. margin	....	49	....	.....	....	....	....	....	....	....	....	.....	....	.....
Depth of caudal peduncle at insertion of flukes	...	29	....	.....	....	34	....	....	....	....	....	.....	....	.....
Center of eye to center of auditory orifice	....	37	36	36½	32	41	39	30	40	35	37½	36	36	36
Length of blowholes	....	....	....	19	....	....	....	....	....	....	....	.....	....	.....
Distance apart of blowholes anteriorly	....	....	....	2	....	....	....	....	....	....	....	.....	....	.....
Distance apart of blowholes posteriorly	....	....	....	8½	....	....	....	...	....	....	....	.....	...	.....
Length of anus	....	4	4	.....	...	...	....	....	....	....	....	.....	....	.....
Anterior margin of anus to tip of clitoris	....	....	20	.....	...	....	....	....	...	....	....	.....	....	.....
Anus to navel	....	...	123	.....	....	....	....	....	....	....	....	.....	....	.....
Length of mammary slit	....	14	....	.....	7⅛	....	...	....	....	....	....	.....	....	.....
Distance between mammæ	....	....	....	.....	....	....	....	....	11	....	....	10½	....	.....
Length of white portion of row of whalebone, right	49	82	66	.....	....	....	....	....	....	....	....	.....	....	.....
Length of longest plates of whalebone (without bristles)	20	20	23½	22	....	....	....	....	24	17½	....	.....	21½	16
Lower jaw extends beyond upper jaw	....	16	....	.....	....	....	....	....	. ..	....	....	....	....	.....
Tip of lower jaw to ant. end of most anterior furrow	16	....	....	.....	...	....	....	....	....	...	....	.....	....	.....
Breadth of flukes	....	....	154	156	140	156	....	144	182	132	182	186	168	.....
Depth of caudal peduncle midway betw. notch of flukes and anus	....	....	....	.....	....	...	....	....	....	....	....	.....	....	64

[1] Twice one half.

[2] Following curve of caudal peduncle.

The following table consists (1) of measurements selected from the foregoing American series and reduced to percentages of the total length, and (2) similar measurements from European records, also reduced to percentages:

BALÆNOPTERA PHYSALUS (L.). NEWFOUNDLAND AND MASSACHUSETTS.

	Snook's Arm, 1899.													Balena Station, 1901. No. 16	Gloucester, Mass. Dwight, 1872.
	No. 11	No. 3	No. 2	No. 19	No. 20	No. 4	No. 13	No. 9	No. 8	No. 1	No. 12	No. 10	No. 7		
Sex	♀	♀	♀	♀	♀	♀	♂	♂	♀	♂	♂	♂	♀	♀	♀
Age	ad.	ad.	ad.	ad.	ad.	ad.								ad.	
Total length	70′ 8″	63′ 7″	63′ 0″	62′ 11″	62′ 8″	61′ 10″	61′ 2″	59′ 1″	57′ 6″	55′ 2″	54′ 6″	53′ 9″	50′ 7″	60′ 11″	48′ 0″
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Tip of snout to eye	20.0	20.4	21.6	19.7	21.5	21.9	20.5	19.3	20.1	....	19.6	20.7	19.8	20.7	20.1
" " " to blowhole (center)	18.2	18.4	18.2	.....	19.7	18.7	18.4	17.2	....	18.6	18 8	18.6	17.6	18.3	.....
Tip of snout to pectoral	....	....	....	32.3[1]	34.5[1]	.....	33.2[1]	32.4[1]	....	....	33.5[1]	33.9[1]	....	33.4[1]	33.8
" " " to back of dorsal	75.7	77.0	....	.....	76.6	79 8	77.6	77.3	77 5	....	77.1	77.3	75.5	75.5	[76.2]
Tip of lower jaw to navel	....	....	....	52.1[2]	52.9[2]	.....	56.5[2]	53.3[2]	55.8[2]	....	55.6[2]	51.5[2]	....	.....	[56.4]
Length of pectoral from head of humerus	12.5	11.5	12.9	12.2	12.8	12.3	11.9	....	12.0	12.9	12.2	11.2	13.1	12.2	11.8
Breadth of pectoral	2.8	2.6	3.0	3.2	3.1	2.7	3.1	2.8	3.0	4.8?	3.1	3.1	3.0	2.9	2.8
Height of dorsal	2.5	2.3	2.6	3.2	2.1	2.7	2.5	2.0	2.4	...	....	....	2.6	2.2	2.4
Breadth of flukes, tip to tip	21.5	20.2	....	24.6	22.3	21.0	24.8	....	22.6	....	20.2	22.3	23.0	.....	.....

BALÆNOPTERA PHYSALUS (L.). EUROPE.

	Pevensey Bay, Eng. (Flower, 1865.)	Wick, Scotland. (Struthers, 1872.)	Peterhead, Scotland. (Struthers, 1871.)	Jalide Bay, Germany. (Brautigam, 1874.)	Finmark, Norway. Figure. (Sars, 1881.)	Langrune, France. (Delage, 1885.)	Stornoway, Scotland. (Struthers, 1872.)	Gravesend, Eng. (Murie, 1865.)	Portsmouth, Eng. (Flower, 1869.)	Borselaer, Netherlands. (Van Beneden, 1871.)
Sex and age	♂ ad.	♂ ad.	♂ ad.	♀	♂ ad.	♂ ad.	♂ ad.	♂ ad.	♂	♂
(1) Total length	65′ 3″	65′ or 66′	64′ 0″	64′ 0″	63′ 4″[3]	61′ 8″	60′ 6″	60′ 0″	59′ 6″[4]	57′ 6″[5]
	%	%	%	%	%	%	%	%	%	%
(2) Tip of upper jaw to eye	[23.0]	.....	20.0	.....	20.0	20.2[4]	.....	19.3	20.2	....
(3) " " " " " blowhole	.....	.....	....	.....	15.6	17.0	.....	.....	17.2[6]	....
(4) " " " " " pectoral	32.2	.....	33.6[1]	.....	....	.....	.....	.....	33.3[1]	....
(5) " " " " " hind margin dorsal	77.6	.....	....	.....	73.8	.....	.....	.....	76.5	[76.0]
(6) Tip of lower jaw to corner of mouth	.....	.....	19.5	.....	....	.....	.....	.....	....	....
(7) " " " " " navel	[60.7]	.....	....	.....	....	.....	.....	.. ..	....	....
(8) Length of pectoral from root	11.5[7]	13.3[7]	12.0[7]	.....	10.0[1]	.....	11.8[8]	11.8[7]	9.0[1]	12.5[7]
(9) Breadth of pectoral	.....	.....	2.5	.....	3.4	.....	.....	.....	2.6	3.4
(10) Height of dorsal	.....	.....	2.0	....	3.0	.....	.....	2.1	2.1	2.3
(11) Breadth of flukes, tip to tip	20.0±	23.1 ±	21.9	.....	....	.....	18.2	18.5	18.5	20.6
(12) Height of body at pectoral	.....	.....	....	.....	18.8	.....	.....	.....	....	....
(13) " " " midway between flukes and dorsal	7.0	.....	7.8	.....	10.3	.....	.....	.....	...	....

[1] To posterior insertion of pectoral, or axilla.
[2] From upper jaw, by subtracting flukes to navel from total length.
[3] All measurements from Sars's figure of 1881, which is excellent.
[4] Straight.
[5] To border of flukes, straight.
[6] To center of blowhole = 18.1 %.
[7] From head of humerus.
[8] Bones, from head of humerus.

BALÆNOPTERA PHYSALUS (L.). EUROPE.—(*Continued.*)

	West of Vardö, Norway. (Cocks, 1886.)	Laman, Orkney Ids. (Heddle, 1856.)	Nairn, Scotland. (Struthers, 1893.)	Crouch R., England. (Crouch, 1891.)	Firth of Forth, Scotland. (Sibbald, 1692.)	Copinshay, Orkney Ids. (Heddle, 1856.)	Charmouth, England. (Sweeting, 1840.)	Christiania, Norway. (Sars, 1868.)	Lofoten Ids., Norway. (Sars, 1865.)	Somme R., France. (Ravin, 1836.)	Kattwyk aan Zee, Netherl. (Schlegel, 1841.)	Wijk aan Zee, Netherl. (Schlegel, 1826.)	Danzig, Germany. (Zaddach, 1875.)
	♂	♀	♂	♀	♂	♂	♀	♀ jr.	♂ jr.	♂ jr.	♂ jr.	♀	♀
(1)	57′ 0″[1]	50′ 0″	49′ 10″	46′ 6½″	46′ 0″	45′ 6″	44′ 0″	43′ 8″	42′ 4″	42′ 0″[2]	41′ 8″	38′ 5″	36′ 0″[1]
	%	%	%	%	%	%	%	%	%	%	%	%	%
(2)	18.0	18.5	19.1	18.3	[18.5]	17.9	....	18.6	18.9	....	15.4[4]	15.1[5]	18.5
(3)	16.6[3]	15.7	16.0	15.8	14.5	....	....	14.7	15.2	11.1	11.3[4]	11.6	14.3
(4)	....	28.7	29.4[6]	25.1[7]	[29.4]	32.9	24.5[8]	28.8	28.9	...	[25.0]	[29.7]	29.1
(5)	....	[72.0]	74.3[9]	74.1	[80.0]	....	[75.0]	72.9	75.2	[77.7]	74.0	73.3	[75.1]
(6)	....	22.5	20.5	....	[20.6]	....	....	20.3	21.7	....	[15.9][4]	19.9[7]	19.6
(7)	....	49.0	...	....	53.3	....	....	50.0	52.3	...	[52.8]	....	54.6
(8)	11.3	12.5[10]	11.9[10]	8.9[10]	10.8	12.2	12.8	10.5	10.1	10.3	[10.7]	6.8[11]	10.0
(9)	....	3.2	2.7	2.3	3.3	2.2	3.4	2.8	2.9	....	2.7	2.5	2.6
(10)	....	3.5	2.3	2.7	2.4	....	2.3	2.2	2.6	1.4	2.5	2.4	2.0
(11)	20.0	20.5	20.5	25.8	20.7	20.9	20.5	21.1	20.9	19.8	.....	21.7	18.4
(12)	....	....	....	....	....	....	....	....	14.8	16.6[12]	15.4	[18.0]	....
(13)	....	7.7 ?	....	....	....	....	....	7.5	8.6	....	7.6[13]	[11.1][15]	....

Leaving out of consideration all immature specimens, or those below 56′ 3″, the following represent the average percentages for different dimensions in American and European specimens respectively:

BALÆNOPTERA PHYSALUS (L.). AMERICAN AND EUROPEAN.

Measurement.	Per Cent. of Total Length.	
	American.	European.
Tip of snout to eye	(10) 20.6	(7) 20.1
" " blowholes (center)	(8) 18.4	(2) 18.1
" " posterior root of pectoral, or axilla	(5) 33.2	(3) 33.4
" " to posterior margin of dorsal	(8) 77.1[14]	(4) 76.0
Length of pectoral from head of humerus	(9) 12.2	(5) 12.5
Breadth of pectoral	(10) 2.9	(4) 2.9
Height of dorsal (vertical)	(10) 2.4	(5) 2.3
Breadth of flukes, tip to tip	(7) 22.4	(8) 20.1[15]

[1] Straight. [2] French measure. [3] To center of blowhole = 18.1%.

[4] The head measurements appear to have been taken from the plate, in which the head is too small.

[5] I suspect that measurements are from the plate (*Neu. Nederl. Verhandl.*, 1 cl., 3, 1831, pl. 1). The eye is obviously too far forward. [6] To axilla = 33.5 %. [7] From figure. [8] From tip of lower jaw.

[9] To middle of fin. [10] From head of humerus. [11] Probably from the plate. The pectoral is too small.

[12] Back of pectorals. [13] At ⅛ the distance from back of dorsal to notch of flukes.

[14] The anterior insertion of the dorsal fin in a fœtus from Newfoundland (No. 14, 1901) is exactly opposite the posterior end of the centrum of the first caudal vertebra.

[15] More or less uncertain, as the measurements in two or three cases are not given with exactness.

The foregoing percentages indicate a remarkable conformity between the American and European specimens in proportions, and such as to be alone almost sufficient to settle once and for all the question of specific identity of this form of whale in the east and west Atlantic. The measurement of the flukes, however, shows a variation of 2 per cent. The importance of this is doubtful, as the measurements given by several European observers are not exact. Furthermore, the American measurements were not made by myself in more than two or three instances, but by an officer on the whaling steamer, as the flukes were generally cut off before the whales were towed into the station.

COLOR.

The descriptions of the color of *B. physalus* given by European authors vary so much among themselves that one might suppose that there was a most extraordinary individual variation in this species, as well as a subspecific variation. It is true that there is a considerable individual variation in color in all species of whales, and no doubt *B. physalus* exhibits this peculiarity, but the differences which have been cited by authors are largely illusive. The species in question is sometimes said to be black above, at other times gray, or even brown, as shown in the following table:

BALÆNOPTERA PHYSALUS (L.). EUROPEAN. COLOR.

Author.	Date.	Color.	Remarks.
Balfour	.....	Deep grayish-slate above; white below	.....
Van Beneden	1857?	All back gray-bluish; all belly white	Found dead. Given at second hand.
Crouch	1891	Upper parts blackish-slate; under parts white	Seen two days after killed.
Cocks	1884	Gray-blue, or grayish slate-color on the back; whole underside white	.....
Guldberg	1884	Above blackish, or else gray-black; underneath white, with a grayish band passing over it	"Now and then one meets with yellowish tinges."
Cocks	1886	Black above; white below	Dead. "Bastard."
Delage	1885	Black above; white below	Dead.
Sars	.....	Rather light gray-brownish, passing over into sepia-color	.....
Struthers	1884	Black on the back; white on the belly	Nairn, Scotland.

It is my opinion that *B. physalus* is never black when alive. The fact is well known, and is commented upon by some of the authors above cited, that whales rapidly turn dark after death, and that descriptions of the color of stranded specimens are, therefore, unreliable. In the Finback whales the epidermis consists of several layers, of which the superficial one is the thickest. When one of these animals is killed and hauled out of the water, the superficial layer at once begins to grow darker, especially if the sun is shining. If a portion of this layer is peeled off, the lighter color of life is found again on the layer below, but in the course of

fifteen minutes this again becomes conspicuously darker than the surrounding parts which are still protected by the superficial layer, as may be seen in a striking manner by peeling off an additional piece of the upper layer, or removing a part of the second layer so as to expose the third.

This deepening of the color goes on gradually in *B. physalus*, and other gray species, until the whole of the pigmented areas are black, and the rejected fragments of blubber from the dorsal region with the skin attached, which are found around a whaling station, are always of this color.

It is obvious that any specimen of *B. physalus* which has been stranded and has lain in the sun for several days before coming to the attention of a naturalist will be described by him as black above. Specimens which have floated dead on the waves, with the back down, for some days, but are observed as soon as brought to land, are more likely to have retained a semblance of their natural color. Such a specimen was described in his usual accurate manner by Sars in 1866 (*77*, 15–16, sep.). With due allowance for the deepening of the tints, this is one of the best descriptions of the coloration of European *B. physalus*. The following is a translation from the Norwegian original:

"The color above in the median line is dark slate, or almost black, but passes on the sides of the body into a very light Isabelline gray, which grades almost imperceptibly into the white of the belly. On the back part of the body (tail) the dark color reaches so deep down on the sides that there remains in the middle (below) a very small white stripe. Directly under the dorsal fin this stripe is smaller and is limited here on both sides by a small, pointed, dark projection, which reaches forward to the anus, where it almost touches the corresponding one of the other side. The white color occupies the whole ventral surface on the most anterior part of the body, and stretches up to the pectorals, back of whose root, however, the dark color of the back sends down a small oval prolongation. Between the root of the pectoral and the corner of the mouth on each side a whitish (not pure white) mark shows itself, which sends out a number of small stripes, of which the most conspicuous are one passing forward in the direction of the eye, and another backward in the direction of the dorsal fin.

"The pectorals are white on the inner surface, but with the tip and along the upper border somewhat dark streaked; on the outer surface they are dark, but here also the white color is seen along the lower border, forming here a small pure white border, which widens out forwards [proximally] not so very insignificantly, until it is suddenly interrupted by a dark tongue-shaped mark passing over the root of the pectoral. The dorsal fin retains the dark color of the back throughout. The flukes are rather dark color on the upper surface, but on the under surface white, surrounded along the edges by a narrow dark border. Of the pectoral furrows, the upper are blue-black within, but the lower, pale flesh-color. The above-described coloration is entirely alike on both sides of the body.

"The most anterior part of the head, or the facial part, however, is very noticeably unequally colored on the two sides. On the left side, the upper jaw, as well as the whole of the upper part of the lower jaw, is dark, but on the right side, not alone the under jaw but the most anterior part of the upper jaw along the border is pure white; but at the root of the lower jaw is an indistinctly defined grayish shade. The dissimilarity in color reaches also to the whalebone. On the left side

it is all dark (blue-black), but on the right side, as Schlegel has stated, the foremost is of a light yellow-white color.

"The bristle-like fibres, into which the whalebone resolves itself on the inner side, are uniform yellow-white on both sides [of the mouth]."

All these peculiarities of color were observed in specimens taken at Snook's Arm, Newfoundland, in 1899, namely (pls. 8 to 11), the narrow inferior white caudal margin, the antero-inferiorly-directed, narrow, dark mark reaching forward to the anus, the areas of dark color below the root of the pectoral, the white mark anterior to the root of the pectoral, with its streaks directed forward and backward, the dark-streaked white anterior border of the pectoral, the white right lower and upper jaws, and whitish anterior right whalebone. In no two individuals, however, were the amount and disposition of the dark color precisely the same, while the want of uniformity of color on the two sides of the body was always conspicuous. As in land animals, there were very pale individuals and very dark individuals, and others which represented neither extreme. In some the inferior caudal margin was entirely dark forward to the anus, and very large dark areas invaded the white of the belly, while the inferior surface and anterior white margin of the pectorals were streaked with dark color, and all light markings were restricted and obscured. In other specimens the white inferior caudal margin was broad and the post-anal dark marks indistinct; the dark color hardly passed below the level of the pectorals, leaving practically the whole belly white, and the white markings about the base of the pectorals were large and distinct.

In the midst of these variations, however, the presence of a dark left lower lip (pl. 11, figs. 3 and 4), white right lower lip, and white anterior right whalebone remained constant, and the right side of the body never carried so much dark color as the left. This peculiar asymmetry of color, or "pleuronectism," was first pointed out by Sars in 1878. Guldberg has more recently asserted that it is not exclusively confined to one side, or, in other words, that an individual might be light on the left side and dark on the right side. My own observations on American specimens do not bear out this statement. The right side in these was always lighter than the left side, and I am disposed to think that this is a constant character of the species. (See pl. 9, fig. 3; pl. 10, figs. 1 and 3; pl. 12, figs. 1 and 2.)

VARIATION IN COLOR OF BODY.

The individual variation in the amount and disposition of the white and gray colors of the body has already been referred to. It may be of interest to enumerate the differences in some of the Newfoundland Finbacks, from notes made on fresh specimens.

In ten specimens the variations were as follows:

No. 2. Female. Length, 64 ft. 8 in. General color dark. Below the left pectoral 35 furrows in the direction of the median line are dark colored. The remaining median furrows are white, with a flesh-colored tinting. Left mandible and upper jaw dark gray. The former whitish internally. Beginning at the

symphysis, the boundary of the dark gray of the left mandible runs obliquely to the left and goes into the fourth left furrow, leaving the first three left ridges white. Below the center of length of left mandible, we first find blackish, or dark gray, ridges, and furrows of the same color, then ridges mottled gray and white, gradually changing toward the median line to all white; then the dark gray of the furrows breaks up into detached blotches; finally both ridges and furrows are white. Opposite the anus the inferior border of the gray of the sides is 16½ in. above the inferior median line of the body. A little behind the anus the gray comes forward and downward in a line. (See pl. 9, fig. 4.)

On the left breast the gray of the sides extends down in broad arms or prolongations. Opposite the middle of the left pectoral, when laid back, the gray extends down so far as to leave only four white ridges above the median line.

The right mandible is all white externally, except that the superior margin is streaked transversely with gray, which is continuous with the dark color of the interior. This dark color runs out at the corner of the mouth and passes back below the eye toward the inferior insertion of the pectoral. From the ear to the head of the humerus is an area of gray lighter than the surrounding color. Under the right pectoral the upper twenty furrows are dark entirely or partly; they are all dark at their anterior ends.

No. 3. Female. Length, 63 ft. 7 in. General color dark. Left mandible dark gray externally, right mandible white. Under the left pectoral the gray comes down over 27 abdominal ridges. The median ridge is streaked with gray about midway between the navel and the line of the extremity of the pectoral, as are also four or five ridges above it on the left side. All furrows at this point from the median line upward are entirely gray, or gray and white blotched. On the flanks the gray comes down to within 27 in. of the navel, to within 18 in. of the vagina, and to within 13 in. of the anus. On the caudal peduncle the gray comes downward and forward in a line toward the anus, and there is also a feather-like inferior median gray band extending backward from the anus. This is followed by gray streaks, so that there is no unmarked white on the inferior median line of the peduncle. The sides and anterior end of the sexual orifice and the inside of the mammary slit are also gray.

No. 4. Female. Length, 61 ft. 10 in. General color light. Eighteen furrows below the root of the pectoral are gray. Opposite the extremity of the pectoral, when laid back, the furrows are all dark, except the three nearest the median line. The white of the exterior of the right mandible occupies also the superior margin in the anterior half, and is continued backward as a narrow light-gray line, which broadens out to a foot in width in front of the eye, and passes over and under it.

Underneath the eye and at the corner of the mouth the color is very light. The inferior border of the gray of the sides is 18 in. above the anus and is without linear prolongations. The inferior surface of the caudal peduncle is, therefore, all white nearly to the flukes, where it is slightly streaked with gray. The anterior boundary of the dark color of the outside of the left mandible runs into the fourth left furrow. (See pl. 9, fig. 2.)

No. 7. Female. Length, 50 ft. 7 in. General color dark. Tip of upper jaw white inferiorly, with a dark median line. Right mandible entirely white. Left mandible dark gray, the anterior boundary of which runs into the fourth left furrow. Gray comes down on the ridges under the left pectoral to within twelve ridges of the median line. Opposite the navel its inferior border is 32½ in. above the same; opposite the anus it is 16 in. above the same. Inferior margin of caudal peduncle all white, with only a trace of the post-anal gray mark. (See pl. 8, fig. 1; pl. 9, fig. 1; pl. 11, fig. 4.)

No. 8. Female. Length, 57 ft. 6 in. General color very dark. Below the left pectoral the gray runs across the breast to the third ridge above the median line. On the right side the gray runs across only a few ridges below the root of the right pectoral, and below the extremity of the pectoral, when laid back, only fourteen ridges. The right breast, throat, and belly, therefore, are nearly all white. Left mandible very dark gray, as is the back. On the sides the gray comes down within 14 in. of the anus. A distinct inferior post-anal gray mark on the caudal peduncle, and the gray comes down so low that at the insertion of the flukes white is almost shut out out from its inferior edge.

No. 9. Male. Length, 59 ft. 1 in. General color dark. The gray color under the pectoral on the left side comes down to within one ridge above the median line. Behind this the white of the belly runs up antero-superiorly to the axilla. Then the gray comes down again to within eight ridges of the median line. Opposite the anus the gray of the sides comes down to a line 15 in. above the median line. Post-anal gray mark distinct. (See pl. 8, fig. 3; pl. 10, figs. 2 and 5.)

No. 10. Male. Length, 53 ft. 9 in. A very light individual, especially on the right side. On that side there is no gray on the ridges in front of the pectoral.

The post-pectoral gray area comes down only to within seventeen ridges above the median line. The post-anal gray mark is distinct.

No. 11. Female. Length, 70 ft. 8 in. General color dark. The gray of the left side comes down across the median line at a point about midway between the line of the navel and the tip of the pectoral, when laid back, and runs up on the right side on seven ridges, there meeting the dark furrows, and thus causing the appearance of a continuous dark band across the belly. Twenty-three furrows downward from the root of the right pectoral are gray. All the central part of the throat and breast from the mandible backward for 31 feet is white, both ridges and furrows. White of the inferior margin of the caudal peduncle very much restricted and clouded with gray streaks. Above the anus the gray of the sides comes down to within 17 inches. Post-anal gray mark very distinct.

No. 12. Male. Length, 54 ft. 6 in. General color very light. No gray on the right side of the belly. On the left side it comes down only to within sixteen ridges from the median line. The anterior boundary of the gray of the left mandible joins the seventh left furrow. The inferior boundary of the gray of the sides is 16 in. above the anus. The post-anal gray mark is very distinct and has a white line dividing it into two inferiorly. (See pl. 11, fig. 1.)

No. 13. Male. Length, 61 ft. 2 in. General color very dark. The gray of

the left side crosses the median line and runs up on nine ridges on the right side. A feather-like gray line fills up all of the inferior margin of the caudal peduncle from the anus to the flukes, leaving no pure white. The post-anal gray mark runs forward and downward on each side close to the median feather-like line, and almost reaches to the anus. (See pl. 8, fig. 4; pl. 11, fig. 2.)

MARKINGS ABOUT THE EYE, AURICULAR ORIFICE, AND ROOT OF PECTORAL FIN.

In *B. physalus*, while the upper surfaces of the body are practically all of a uniform gray color, the region between the eye and the pectoral fin is varied by markings of different shades of gray, which are very conspicuous in some individuals. These markings are represented in a rather indifferent manner in Sars's figure of his Lofoten Ids. specimen (*77;* pl. 1, figs. 1 and 2; pl. 2, fig. 1), and are mentioned by him as follows: "Between the root of the pectoral fin and the corner of the mouth, on each side above, a whitish (not pure white) mark shows itself, which sends out above a number of small stripes, of which the most conspicuous are one passing forward in the direction of the eye, and another backward in the direction of the dorsal fin" (*77*, 15, sep.).

In the Newfoundland Finbacks (pl. 11, fig. 1) the most constant and noticeable marking of the region above mentioned is a whitish line which starts at the auricular orifice on the right side, curves strongly upward, then downward, and terminates at or above the anterior insertion of the pectoral fin. On the left side another light line usually starts at the eye, and may run under or through rather than over the ear, and terminate at the insertion of the pectoral. This line is usually much lighter than the surrounding surfaces, and is often bordered with dark gray. This light line in some cases broadens out at the posterior end and merges into a large white area of irregular shape and imperfectly defined borders above the root of the pectoral. This is the area mentioned by Sars. Besides these markings, in some individuals a distinct gray band, darker than the surrounding surfaces and about as wide as the eye, starts just above that organ, and running obliquely upward and backward broadens out into a large ill-defined dark gray area on the shoulder. This dark area is itself invaded by a large, V-shaped, double, white marking, producing a very complicated succession of tints in this region. The white or whitish mark above the root of the pectoral sometimes extends backward and involves the basal portion of the fin itself, and may be separated off from the color of the distal part of the pectoral by a very dark line. (See pl. 10, fig. 3.)

These various markings are more distinct on the right side than the left, and appear in different combinations, but the light line may almost invariably be detected, and is quite distinct in fœtal specimens. In a freshly-obtained fœtus, 12 ft. 9 in. long, the back was of a beautiful cerulean blue, and a very light line began at the anterior corner of the eye and passed back over the eye (becoming there almost white) and thence backward just above the auricular orifice. Then it curved upward and backward over the root of the pectoral and was lost in the

general color of the surrounding parts. A light line began at the ear and curving in a semicircle was lost in the region above the root of the pectoral.

In adults the side and top of the head below and in front of the dark oblique eye-line is usually lighter than the back.

There is commonly a light gray, or whitish, mark under the eye, especially on the right side, and sometimes a similar mark around the right ear.

HAIRS.

In the Newfoundland Finbacks, at the tip of the mandible and following the line of the symphysis on each side, are two rows of thick but soft whitish bristle-like hairs, about ½ in. long. There are about fifteen hairs in each row. In a male fœtus 6 ft. 5 in. long there were nine hairs on the right side of the lower jaw, in a row running obliquely downward and backward and terminating above the tenth right furrow. On the right upper jaw were twelve hairs, beginning about six inches from the top of the jaw and irregularly disposed. Around the root of each hair was a light-colored ring.

DORSAL FIN.

The dorsal fin in the Newfoundland Finbacks showed a considerable variation in size, as in European specimens. The following are the actual vertical heights in various Newfoundland specimens:

BALÆNOPTERA PHYSALUS (L.). SNOOK'S ARM, NEWFOUNDLAND. DORSAL FIN.

No.	Sex.	Length of Whale.	Vertical Height of Dorsal.
		ft. in.	
11	♀	70 8	21 in.
2	♀	64 0	20 "
3	♀	63 7	17.5 "
19	♀	62 11	24 "
20	♀	62 8	16 "
4	♀	61 11	20 "
13	♂	61 2	18.5 "
9	♂	59 1	14 "
8	♀	57 6	19 "
7	♀	50 7	16 "

The dorsal fin in these Finbacks is subject to a considerable variation in form, being normally falcate, but with the tip sometimes longer and more acute, and sometimes shorter and more rounded; the posterior margin in some individuals moderately concave, in others strongly concave. (See text figs. 1–7 and pl. 11, fig. 5.) The variation is, however, less marked and striking than is found in the Sulphurbottoms. The normal shape of the dorsal in European specimens of *B. physalus* is well shown in Sars's figure of his Lofoten Ids. specimen (*77*, pl. 2, fig. 5). In color the dorsal fin agrees with the dark gray of the adjacent part of the back. In one instance (No. 2, Snook's Arm) there was an irregular, pure-white blotch close to the tip of the fin, on the right side.

FIG. 1.

FIG. 5.

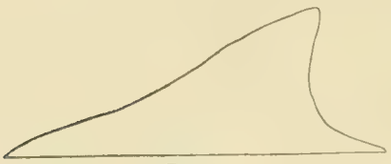


FIG. 2.

FIG. 3.

FIG. 6.

FIG. 4.

FIG. 7.

DORSAL FIN OF *BALÆNOPTERA PHYSALUS* (L.). AMERICAN AND EUROPEAN.

FIG. 1.—SNOOK'S ARM, NEWFOUNDLAND. AD. ♀. No. 24. FIG. 2.—SNOOK'S ARM, NEWFOUNDLAND. AD. ♀. No. 25. FIG. 3.—SNOOK'S ARM, NEWFOUNDLAND. AD. ♀. No. 23. FIG. 4.—GLOUCESTER, MASS., IM. ♀. (FROM DWIGHT.) FIG. 5.—FINMARK, NORWAY. AD. (FROM MALM.) FIG. 6.—BORSELAER, NETHERLANDS. AD. ♂. (FROM VAN BENEDEN.) FIG. 7—LOFOTEN IDS., NORWAY. JR. ♂ (FROM SARS.)

PECTORAL FIN.

The shape of the pectoral fin in the European *B. physalus*, according to Sars is "narrowly lanceolate, with the posterior angle often but little distinct." This is true of the Newfoundland Finbacks. The anterior border is much straighter than in the Sulphurbottoms, and the distal half of the posterior margin, which is quite strongly concave in the latter, is straight in the Finback. These straight contours and the small size give the pectoral of the Finback a triangular appearance, quite different from that of the Sulphurbottom, as will be seen by comparing pl. 11, figs. 1, 2, and 4, and pl. 21. The shape of the pectoral of *B. physalus* is not as well shown in Sars's figure (*79*, pl. 2) as in Delage's photographs (*33*). In the former the anterior margin is too much curved, especially in the proximal half, and the posterior margin is too convex near the axilla. Much better are Sars's lithographic figures of his Lofoten Ids. specimen (*77*, pl. 2, figs. 3 and 4), in which the triangular shape of the pectorals is admirably portrayed, though perhaps a little exaggerated.

There is some variation in the relative length and width of the pectoral, as will be seen by consulting the table on p. 117, but it is not sufficient in any case to destroy the characteristic shape of the fin.

In some Newfoundland specimens the contours are much more regular than in others, and in No. 17 there was a deep emargination at the tip anteriorly, due possibly to injury. In No. 3 the tip of the left pectoral was blunt and irregular, due to injuries.

The color of the pectorals is normally gray on the external surface, like the back, and white on the internal surface and anterior border.

In some Newfoundland specimens the dark-gray external surface was more or less marked with lighter gray, and the light-gray area at the root of the pectoral, already described (see p. 121), sometimes invades the pectoral, so that the proximal $\frac{1}{4}$ of the external surface may be abruptly and conspicuously lighter than the remainder. The light area may be defined posteriorly by a dark gray line running across the pectoral to the axilla and thence to the back.

The anterior thick margin is always white, but this color in some instances extends much farther upon the external surface of the fin than in others, especially at the tip. The margin itself is usually more or less streaked with gray, and in some instances is entirely gray for some distance from the root of the fin, or there may be a gray patch near the middle of the border.

The internal surface of the fin is sometimes entirely white, or with but a narrow posterior border of gray, but in most cases the posterior two thirds shade more or less into gray, especially toward the tip. The tip underneath is commonly marked with gray lines, either parallel or reticulated. In the majority of cases there are one or two long gray lines running backward from the tip parallel with the long axis of the fin, and corresponding in position with the intervals between the digits. These lines are of so frequent occurrence as to be characteristic of the species.

FLUKES

The flukes in the Newfoundland Finbacks (pl. 12, figs. 7–8) were long and slender, with acuminate and strongly recurved tips. The anterior border is convex, the posterior slightly convex near the median line, then nearly straight, and finally strongly concave at the tips. The median notch was shallow and more or less open in different individuals.

The flukes are gray on the superior surface, like the back. On the inferior surface they are all white, except on the margins. The posterior margin is gray throughout; this color, however, having a wider extension distally than proximally. The anterior margin is gray distally, but the white usually invades this margin proximally. The tip is gray. Near the median line the posterior gray border is about 7 in. wide and the anterior 2 in. or less. The gray borders fade out into streaks which run transversely, or as if radiating from the end of the spine, and this arrangement doubtless gave rise to the erroneous fish-like tail, with rays, seen in some early figures. The transverse streaks on the anterior margin are crossed by others running fore and aft, especially near the root of the flukes. (See also pl. 12, fig. 5.)

WHALEBONE.

One of the principal characters of *B. physalus*, which was early recognized, is the party-colored whalebone. Later it was discovered by Sars and others that the whalebone of the anterior end of the series of the right side is always white.

Some individuals, however, have a few white plates on the left side, in addition to the large series on the right side.

In a whale 55 ft. 2 in. long (No. 1), the length of the white portion of the right whalebone series was 4 ft. 1 in., and comprised 166 plates. In No. 2, which was 64 ft. 8 in. long, the white area had a length of about 6 ft., and comprised about 200 plates. In No. 4, ♀, 61 ft. 10 in., the white whalebone area was 4 ft. 2 in. long. No. 7, ♀, 50 ft. 7 in. long, had 270 anterior white plates on the right side. No. 10, ♂, 53 ft. 9 in. long, had about one half the right whalebone, or about 210 plates, white. Only a small number of the most anterior plates in this individual were entirely white, the other anterior ones being white externally, but gray internally.

From the foregoing figures it will be evident that the extent of the white portion of the whalebone is not always the same, nor is it proportional to the length of the individual. (See also pl. 12, fig. 6.)

The streaked whalebone shows the most extraordinary variety as regards the width and number of light and dark streaks. As a rule, however, the dark streaks prevail more and more toward the posterior end of the series, and the plates here are commonly quite uniform dark gray. The darkest color is on the exterior edge. The matted surface of bristles appears whitish when looked at in the direction of the roof of the mouth, with a rather broad margin of dull brown where the whalebone plates are dark externally. The width of the throat is about 7 inches. The plates of whalebone are reduced to nothing posteriorly, the short, matted bristles being attached directly to the integuments of the mouth, the curly masses of the two sides approaching each other posteriorly within 5 inches. (See pl. 11, fig. 6; pl. 12, figs. 3 and 4.)

The length of the longest whalebone in various European and American specimens is given in the following table:

BALÆNOPTERA PHYSALUS (L.). AMERICAN AND EUROPEAN. LENGTH OF WHALEBONE.

Locality.	Length of Whale.	Sex.	Length of Longest Whalebone.	Author.
	ft. in.		in.	
Crouch R., England	46 6½	♀	22[2]	Crouch
Pevensey Bay, "	65 3[1]	♂	23[3]	Flower
Portsmouth, "	59 6[1]	♂	21[3]	"
Gravesend, "	60 0	♂	30[2]	Murie
Wick, Scotland	65 or 66 0	♂	21[4]	Struthers
Stornoway, Scotland	60 6	♂	30[4]	"
Notre Dame Bay, Newfoundland	70 8	♀	24[5]	F. W. T.
" " " "	64 8	♀	20[5]	"
" " " "	63 7	♀	23.5[5]	"
" " " "	62 8	♀	21.5[5]	"
" " " "	61 10	♀	20[5]	"
" " " "	55 2	♂	20[5]	"
" " " "	54 6	♂	17.5[5]	"

[1] Straight. [2] Whether includes bristles not stated. [3] Including the hairy ends.
[4] Exclusive of bristles. [5] From the surface of the gums and exclusive of the bristles.

ABDOMINAL RIDGES AND FURROWS.

In *B. physalus* the abdominal ridges and furrows are broader and less numerous than in *B. acuto-rostrata*, much narrower and more numerous than in the Humpback. They are parallel for the most part, but anastomose frequently at different points. Sars's description of the furrows in an European (Lofoten Ids.) specimen is as follows (*77*, 13 and 14 sep.):

"The breast furrows, which are very characteristic of the fin-whales, occupy the whole of the anterior half of the ventral side of the animal, from the tip of the mandible to the navel. In the present species they are quite numerous and extend well up on the sides of the body. In a straight line around the ventral surface about 70 furrows may be counted. The middle ones extend far backward to the very sides of the navel; the others become little by little shorter upward, so that the posterior boundary of the furrowed area on the sides forms a line passing obliquely from the navel to the root of the pectoral fin. These furrows as a whole run nearly parallel with the long axis of the body and each other, but are often interrupted, so that a new one takes its origin a little in front of the place where another ends. On the sides of the neck, or between the corner of the mouth and the root of the pectoral, the furrows extend farthest up on the side of the body, and their course is here less regular. From the corner of the mouth, four short furrows run backward and are somewhat sigmoid, and one approaches near the root of the pectoral. From the root of the mandible run 8 furrows of unequal length, which converge posteriorly without reaching the root of the pectoral; they thus lie between the lowest of those from the corner of the mouth and the first which runs forward from the root of the pectoral, with which the furrow following most closely takes a quite strongly curved course. At the root of the pectoral fins both above and below are a number of short strongly curved furrows."

In the Newfoundland specimens the arrangement of ridges and furrows was the same, as will be seen on examining pls. 8 and 9. The number and course of the furrows are, however, subject to considerable variation. In some cases the furrows in the root of the mandible are continuous with those running forward from under the pectoral, and form one series with them. One or two pairs directly on the median line of the throat are shorter anteriorly than the lateral ones, so that there is quite a large plain area immediately under the tip of the mandible.

The total number of furrows between the two pectorals varies considerably in different Newfoundland specimens, as follows: No. *1*, about 80; No. *2*, 62; No. *7*, 72; No. *13*, 78; No. *4*, 56; No. *9*, 62; No. *20*, 76. These totals were obtained by counting from the median line to the root of the pectoral on one side and multiplying by two. The average is the same as in Sars's Lofoten Ids. specimen.

The breadth of the ridges in the vicinity of the middle of their length in Newfoundland specimens was 2 in. to 2½ in., but at the posterior ends they increased in breadth to 4 inches. The breadth of the furrows depends chiefly on the pressure exerted from the interior of the body, though they do not always close together when this pressure is withdrawn. In the dead animal, the weight of the integuments which happen to be nearest the ground pulls the ridges which are higher up

more or less apart. The furrows on the mandible appear to remain always open, and the skin at their base is smooth and hard, while that of the breast furrows is soft and obliquely wrinkled.

The ridges, as already remarked, anastomose irregularly and to a varying degree in different individuals. Many pairs coalesce near the posterior end, so that the total number of ridges here is much less than on the breast.

The color of the ridges and that of the intervening furrows do not always agree. Where there is a solid area of dark gray on the ridges, the furrows are also dark. Where the dark color of the ridges breaks up into blotches, that of the furrows commonly remains uniformly dark for a considerable distance farther toward the median line of the belly. Finally, however, it also breaks up into blotches; and along the median line both furrows and ridges are pure white. In a few cases there are moderate-sized areas of gray on the ridges where the furrows are entirely white, but this condition is of much less frequent occurrence than the opposite.

AURICULAR ORIFICE.

As is well known, the whales are without an external ear-conch. The external auricular orifice is in the form of a small oblong, or occasionally circular, opening, situated at a short distance behind the eye and nearly in the same horizontal plane. In the Newfoundland Finbacks the orifice is about 3 in. long and varies somewhat in position in different individuals, as will be evident from an inspection of the following table:

BALÆNOPTERA PHYSALUS (L.). NEWFOUNDLAND.

No.	Sex.	Total Length.	Distance from Center of Eye to Center of Ear.
		ft. in.	in.
11	♀	70 8	40
3	♀	63 7	36
19	♀	62 11	36
20	♀	62 8	36
4	♀	61 10	36.5
B. 16	♀	60 11	36
9	♂	59 1	39
8	♀	57 6	41
12	♂	54 6	35
10	♂	53 9	30
7	♀	50 7	32

EYE.

In the Newfoundland Finbacks there is always a ridge, bounded above and below by converging furrows, at the anterior commissure of the eyelids, and one or two short furrows both above and below the eye. (See pl. 9, fig. 5.) In No. 2, ♀, the orifice between the lids was 3½ in. long, the long axis of the iris 2 in., the long axis of the pupil ¾ in., and the diameter of the eyeball 5 in. In No. 16

of 1901, the orifice between the lids was 4 in. long, the iris 2 in. in diameter longitudinally and 1¼ in. vertically; pupil 1⅜ in. by ½ in.

The iris is brown, with a white border narrow and irregular. The pupil is elliptical, with the long axis fore and aft.

OSTEOLOGY.

The osteological characters of *B. physalus* have been abundantly described by European authors, and especially by Eschricht, Van Beneden, Flower, Struthers, and Turner. The skull and other parts of the skeleton have been figured several times by Van Beneden and Gervais, Eschricht, and others. The American specimens allied to *B. physalus* which have fallen under my notice are the type of *B. tectirostris* (Cope), two skeletons in the U. S. National Museum, one in the State Museum, Albany, N. Y., one at Ward's Natural Science Establishment, Rochester, N. Y., one in the Museum of Comparative Zoölogy, Harvard University, and one in the museum of the Boston Society of Natural History. The last was described by Dwight in 1872. The species was characterized by Flower in 1864 (*45*, 392) as follows:

"Total number of vertebræ 61–64. Ribs 15 pairs. Orbital process of frontal bone considerably narrowed at its outer end. Nasal bones short, broad, deeply hollowed on their superior surface and anterior border. Rami of the lower jaw massive, with a very considerable curve, and a high, pointed, curved coronoid process. Neural arches of the cervical vertebræ low; spinous processes very slightly developed. Transverse process of the atlas arising from the upper half of the side of the body, long, tapering, conical, pointed directly outwards. Upper and lower transverse processes, from the second to the sixth vertebra, well developed, broad, flat (and united at the ends in the adult, forming complete rings?). Head of the first rib simple, articulating with the transverse process of the first dorsal vertebra. Second, third, and sometimes the fourth ribs with capitular processes, reaching nearly to the bodies of the vertebræ. Sternum broader than long, in the form of a short, broad cross, of which the posterior arm is very narrow; it might perhaps be compared to the heraldic trefoil; it is subject, however, to considerable individual modifications."

SKULL.

There appears to be no entirely satisfactory drawing of the skull of an European specimen of *B. physalus*. Lacepede's figure from the St. Marguerite Id. specimen (*Hist. Nat. Cét.*, 12°, 1, pl. 6) is quite imperfect and indistinct. Cuvier's figure from the same specimen (*Oss. Foss.*, 3d ed., 5, pl. 26, fig. 5) is better, but the muzzle is obviously too sharp. Eschricht's figure (*Nordhvalen*, pl. 3, fig. 3) is still better, and in many respects very satisfactory, but the frontals appear to be too narrow distally and the occipital region is too short. Van Beneden and Gervais's figure (*8*, pl. 12, fig. 12) is in many respects an improvement on Eschricht's, but the perspective and detail of the posterior portion leave much to be desired. Sars's figure (*77*, pl. 3, figs. 1–2) of an adult skull in the Christiania Museum is on the whole the best.

Better than all these hand-drawings is the set of photographs of the Danzig specimen published by Menge (*69*, photos.). Menge was under the impression

that his specimen represented *B. laticeps* Gray, a synonym of *B. borealis* Lesson, but it is in reality *B. physalus*, as is indicated by the number of vertebræ, color of body, color of whalebone, etc.

It must be admitted that the correspondence between Menge's figures and those of American specimens on pls. 1–4 is very close. The skull appears to differ less from the American specimens than they do from one another, except in one particular. The width of the vertex appears to be less in Menge's photograph than in the American specimens, and the proximal end of the nasal process of the maxilla narrower. This same feature is to be observed in the figures of Eschricht and of Van Beneden and Gervais, and may constitute a real difference between the American and European skulls. It is to be noted, however, that Dwight's figure of the Gloucester, Mass., skull has the vertex and maxilla even narrower than Menge's photograph, but this figure is not correct as regards the intermaxillæ and may be otherwise inaccurate.

In Sars's figure of an European skull, the width of the vertex is as great as in the American specimens, and the occipital border is straight as in the Rochester (New York) specimen. In the type of *B. tectirostris* (Cope), the margin of the supraoccipital is convex forward at the vertex (pl. 1, fig. 1). The breadth of the vertex is 13½ inches.

As already mentioned, the American skulls differ very considerably among themselves. It will be noted, for example, that the Cape Cod specimen, No. 16039, U. S. N. M., agrees with the type of *B. tectirostris* (Cope) in having very sharp-pointed nasals (pl. 1, fig. 3), while the Cape Cod skull, No. 16045, U. S. N. M., agrees with the Rochester (New York) skull in having blunt nasals. (Compare pl. 1, fig. 2 and pl. 3, fig. 1.) The form of these bones in No. 16045 is precisely that given by Flower for an European specimen in the Royal College of Surgeons, London (*P. Z. S.*, 1864, p. 390, fig. 4). This Rochester skull is peculiar in having the antero-superior margin of the occipital quite square, while in the other skulls the margin is more or less semicircular. It is a mature specimen, while the others are immature.

The proportions of the skulls, as indicated by comparative measurements, would constitute an excellent criterion of likeness or unlikeness. Unfortunately, detailed measurements of skulls of European specimens have been published in but a few instances, and these are not always comparable. In the first table on page 133 a number of such measurements, reduced to percentages of the total length, for both European and American specimens, are brought together.

As the American specimens at command are all immature, it is necessary in instituting comparisons to exclude all the mature European specimens. Unfortunately, this leaves but one European specimen, that stranded at Nairn, Scotland, and reported by Prof. Struthers (*88*, 330). As Struthers's measurements can, however, be thoroughly relied upon, and as all of the American specimens except one were measured by a single observer (myself), this comparison may be regarded as of more value than would ordinarily be the case. The average percentages for the American specimens, including the type of *B. tectirostris* (Cope), and the percentages for the Nairn specimen are as indicated in the second table on page 133.

BALÆNOPTERA PHYSALUS (L.). EUROPEAN AND AMERICAN. SKULL.

	Falmouth, Eng. Alexandra Park. (Flower, 1869.)	Vlieland Id., Netherl. Antwerp Gardens. (Flower, 1864.)	Gravesend, Eng. Rosherville Gardens. (Murie, 1865.)	Christiania Mus. (Sars, 1865.)	Nairn, Scotland. (Struthers, 1889.)	B. sp. ? California. (Wistar Inst., Phila.)	Gloucester, Mass. (Dwight, 1872.)	Cape Cod, Mass. (16045, U. S. N. M.)	Type: *B. tectirostris* (Cope.) Phila. Acad. Nat. Sci.	Cape Cod, Mass. (16039, U. S. N. M.)
Sex and age	♂ ad.	♂ ad.	♂ ad.	.....	♂	ad.	♀	jr.	jr.	jr.
Total length of whale	.....	72′ 2″	60′ 0″	betw. 50′ 0″ and 60′ 0′	50′ 0″	68′	48′ 0″	.....	.....	.....
" " " skeleton	66′ 0″ straight	67′ 6″	.....	.....	.....	62′ 10″+	.....	47′ 7″	.....	.....
Length of skull (straight)	186″	184″	168″	156″	145.0″	194″ [1]	144″	125″	121″	110.5″
Greatest breadth (squamosal)	% 46.2	% 52.2 [2]	% 44.8	% 46.1	% 45.8	% 48.0	% 46.5	% 48.0	% 44.6	% 47.0
Breadth of orbital process of frontal at distal end	9.1	9.8	.....	.....	10.7 [3]	10.3 [4]	.....	10 4 [5]	10.0 [6]	11.3 [7]
Length of beak (straight)	71.0	72.3	69.0	69.3	66.2	69.1 [1]	69.4	67.2	66.1 [8]	65.2
Breadth of beak at middle (curved)	19 3	18.0	19.6	23.1	18.6	21.4	19.4	20.0	21.9	19.4
Length of nasals	3.8	4.6	4.9	.....	5.2	.....	4.2	5.0	5.6	5.4
Breadth of 2 nasals at distal end	4.0	5.0	4.2	.....	5.9	.....	6.6	5.2	5.2	4.9
Length of mandible (straight)	95.2	98.0	92.8	.....	93.1	94.8	95.4	94.4	91.8	.....
Length of mandible (curved)	.....	.....	.....	.....	98.6	101.5	.....	103.2	100.0	.....
Depth of mandible at middle	7.0	.....	7.1	.....	6.2	7.0	6.9	6.4	7.9	.....

BALÆNOPTERA PHYSALUS (L.). EUROPEAN AND AMERICAN. SKULL.

Measurement.	American Specimens.		Nairn, Scotland.
Total length		100.0 %	100.0 %
Greatest breadth	(3) [9]	47.1	45.8
Breadth of orbital border of frontal	(3)	10.6	10.7
Length of beak	(3)	67.2	66.2
Breadth of beak at middle	(3)	19.6	18.6
Length of nasals	(4)	5.1	5.2
Breadth of nasals	(4)	5.5	5.9
Length of mandible in straight line	(3)	93.9	93.1
Depth of mandible at the middle	(2)	6.7	6.2

The agreement shown in the foregoing measurements is very close except in the case of the breadth across the squamosals. In regard to this measurement, it must be said that in all specimens of the several species of *Balænoptera* it exhibits a considerable range of variation, indicative in part of a real individual variation of considerable extent, and in part, no doubt, to changes in the skulls in drying.

[1] 7.5 in. added for premaxillæ.
[2] Squamosals peculiarly broad. See Flower.
[3] Least = 6.9 %.
[4] Least = 5.5 %.
[5] " = 7.2 %.
[6] " = 7.2 %.
[7] Least = 7.2 %.
[8] To post. curved margin of maxilla.
[9] Number of specimens; the California skull is not included.

NUMBER OF VERTEBRÆ.

Various European authors have recorded the number of vertebræ in specimens of *B. physalus*. These specimens were frequently not absolutely complete, and as there is some individual variation, the formulæ of different observers show a certain lack of conformity. This affects particularly the caudal vertebræ, the most posterior of which are generally lacking in specimens preserved in museums. In the following table a number of records are brought together for comparison in the original form, and on p. 137 the several vertebral formulæ are modified in accordance with various indications which are discussed on a subsequent page.

BALÆNOPTERA PHYSALUS (L.). EUROPEAN. VERTEBRAL FORMULA.

Author.	Locality.	Date.	C.	D.	L.	Ca.	Total.
Flower	Vlieland Id.	1851	7	14 [1]	14 or 15 [2]	23 or 24	60 [3]
"	Katwijk	1841	7	15	14	24	60
"	Falmouth	1863	7	15 [4]	14 [5]	25	61 [6]
Flower and Gray	Isle of Wight	1842	7	14 [7]	15	18 + [8]	54 +
Van Beneden	Borselaer	1869	7	14	15	25	61
Lilljeborg	(Bergen Museum)	(1862)	7	15	15	25	62
Heddle	Laman Id.	1856	7	15	— 4 o	—	62
Struthers	Nairn	1884	7	15	15	25	62
Delage	Langrune	1885	7	14	15	26 [9]	62
Fischer	St. Vigor	1847	7	14 [10]	16	25	62
"	St. Cyprien	1828	7	14	15	24 [11]	60
Menge	Danzig	1874	7	14 [12]	15	24	60

[1] "It is most probable that the 15th pair has been lost." (Flower, *P. Z. S.*, 1864, p. 415.)

[2] "According to Van Beneden, fourteen or fifteen lumbar, though the place of attachment of the first chevron bone in the skeleton indicates but thirteen as belonging to this series." (Flower.)

[3] "The number of vertebræ is 61, the last being modelled in wood; but from the character of the 60th I should say that there ought to be 2 below it." (Flower, *P. Z. S.*, 1864, p. 414.)

[4] "The last pair was quite rudimentary and unconnected with the spinal column." (Flower, *P. Z. S.*, 1869, p. 609.)

[5] "The chevron bones appear to be all present. There are 18." (Flower, *P. Z. S.*, 1869, p. 608.)

[6] "There are 61 vertebræ; but the last is elongated and constricted in the middle, as if it really consisted of 2 united." (Flower, *l. c.*)

[7] "The last well developed. There may have been a 15th pair." (Flower, *l. c.*, p. 610.)

[8] "Caudal vertebræ 18, exclusive of those contained in the fin of the tail, which is preserved entire." (Gray, *Zoöl. Erebus and Terror*, p. 50.)

[9] "At the end of the 25th was found a little conical cartilage. . . . It seems to me to represent a 26th caudal." (Delage.)

[10] "The last rib is more elongated than the preceding ribs." (Fischer, *Cét. S. O. France*, p. 75.)

[11] "It is probable that the last caudals were lost during dissection." (*Ibid.*, p. 79.)

[12] The 14th pair of ribs, as shown by the photograph, was as long as the preceding pair.

Formulæ for various American specimens are as follows:

BALÆNOPTERA PHYSALUS (L.). AMERICAN. VERTEBRAL FORMULA.

Museum.	Locality.	Date.	C.	D.	L.	Ca.	Total.
U. S. Nat. Mus., No. 16045	Cape Cod, Mass.	1876?	7	14[1]	15[2]	22 (+ 3?)	58 (+ 3?) = 61
Albany State Mus.	" " "	1880	7	14[1]	16	25	62
Ward's Estab., Rochester	Provincetown, Mass.	1893	7	15	14	..	..
Mus. Comp. Zoöl., Cambridge, Mass.	" "	1880	7	15	15	26	63
Mus. Boston Soc. Nat. Hist.	Gloucester, Mass.	1870	7	15[3]	15	26	63
Mus. Acad. Nat. Sci. Phila.	Sinepuxent Bay, Md.	1868–9	7	..	15	..	..
U. S. Nat. Mus.[4]	Newfoundland.	1901	7	16	14	25	62

These various formulæ exhibit a considerable divergence, with no special line of separation between the American and European specimens. As already remarked, several of the formulæ require a certain amount of modification because the specimens were somewhat defective, the number of ribs and chevron bones actually present probably being less than the original number. These modifications will now be considered, and afterwards a revised table of formulæ.

RIBS.

In skeletons of *B. physalus* which have been examined under favorable conditions, it has been noted that the last pair of ribs is much shorter than the penultimate pair and is not attached to the vertebral column. In other words, the last rib is normally a "floating" rib. It has also been observed that the first chevron bone is smaller than the second. These facts and other indications lead to the belief that museum skeletons in which the last pair of ribs is as long as the preceding pair and the first chevron as large, or nearly as large, as the second are defective in these parts. Granting this assumption to be correct, we will consider the various formulæ in the preceding tables.

Regarding the Vlieland Id. skeleton (1851) Flower remarks: "There are 14 pairs of ribs present; but as the 14th has not the characters usually met with in the last rib, and as the 15th vertebra has the end of the transverse process thickened and showing traces of an articular surface, it is most probable, as Van Beneden supposes, that the 15th pair has been lost." (*P. Z. S.*, 1864, p. 414). Flower also remarks that though Van Beneden cites 14 or 15 as the correct number of lumbar vertebræ "the place of attachment of the first chevron bone in the skeleton indicates but 13 as belonging to this series." (*Ibid.*, p. 414). The formula for this skeleton with these corrections would be: 7, 15, 13, 27 = 62.

[1] The 14th pair of ribs is as long as the preceding ones, and hence an additional pair is doubtless to be counted.

[2] As the first chevron in position is of large size, it is probable that an anterior one is wanting. The condition of the inferior carina of vertebra No. 36 indicates that such was the case.

[3] The 15th pair of ribs is as long as the preceding pair, and hence 16 pairs may have been present originally.

[4] Fœtal.

For the Borselaer skeleton (1869) Van Beneden gives 14 pairs of ribs, but as the last pair is as long as the preceding one probably another should be counted, so that the formula would stand 7, 15, 14, 25 = 61. For the same reason one dorsal should be added in the case of the St. Vigor skeleton (1847), so that the formula would be 7, 15, 15, 25 = 62, and in the case of Menge's Danzig skeleton (1874), making the formula 7, 15, 14, 24 = 60.

Some of the American specimens appear to require modification in the same manner.

The Cape Cod skeleton, No. 16045, as mounted, has 14 pairs of ribs and 15 lumbar vertebræ. The 14th pair of ribs, however, is as long as the 13th pair, and hence it is very probable that an additional pair, or 15 in all, should be counted.

The inferior carina of the vertebra immediately in front of the one to which the first chevron is attached is divided posteriorly, and it is probable that another chevron was originally attached there. The first chevron in position is large. Such being the case, and considering the statement just made regarding the ribs, the number of lumbar vertebræ would be reduced to 13. The formula would then be 7, 15, 13, 23 + = 58 +. This formula appears exceptional in *B. physalus* unless such European authorities as Flower, Delage, Fischer, etc., have been mistaken. It will be noted, however, that Flower (*45*, 414) proposes 13 lumbars for the Vlieland Id. skeleton.

The formula given by Dwight (*35*, 212) for the Gloucester (Mass.) skeleton is 7, 15, 15, 26 = 63. He states, however, that the inferior carina of the 15th lumbar is bifurcated posteriorly, and hence it is possible that it belongs to the caudal series. His measurements show that the 15th pair of ribs is as long as the preceding ones, and it may be that a 16th "floating" pair originally existed. In case these conditions existed, the formula would be 7, 16, 13, 27 = 63.

In the skeleton in the State Museum, Albany, N. Y., the 13th rib is 5 ft. 7 in. long, while the 14th and last rib is 5 ft. 2 in. long. It thus appears that at least one additional pair of ribs was probably present originally.

The first and second chevron bones in position are alike in size, from which it may be inferred that a smaller anterior one is missing. If these inferences are correct the vertebral formula for the skeleton would be 7, 15, 14, 26 = 62.

In the skeleton in the Museum of Comparative Zoölogy, Cambridge, Mass., the 15th pair of ribs is as long as the 14th pair, so that it is quite likely there was originally a 16th pair. As to the chevrons, the first in position is only about one fourth the size of the second, showing that no more are to be allowed for in that direction. With the modification indicated, the formula for this skeleton would be 7, 16, 14, 26 = 63.

The Newfoundland fœtus which I carefully dissected had 16 pairs of ribs. This number was also found by Struthers in the Peterhead specimen (*Journ. Anat. and Phys.*, 1871, p. 116). This 16th rib on the right side was 30 in. long, on the left side, 22 in.. The 15th pair of ribs was 72 in. long. Flower states that in the Margate skeleton the 15th pair of ribs was nearly as long as the 14th, so that there may have been a 16th pair in this skeleton also. (*P. Z. S.*, 1869, p. 608.)

It appears, therefore, that in European specimens the number of ribs varies from 14 to 16 pairs, and in American specimens, 15 to 16 pairs.

With the modifications indicated above, the various European and American formulæ will stand as follows:

BALÆNOPTERA PHYSALUS (L.). EUROPEAN AND AMERICAN. VERTEBRAL FORMULA, REVISED.

Author or Museum.	Locality.	Date.	C.	D.	L.	Ca.	Total.	Remarks.
			EUROPEAN.					
Flower	Vlieland Id.	1851	7	15	13	27	62	
"	Katwijk	1841	7	15	14	24	60	
"	Falmouth	1863	7	15	14	26	62	
Flower and Gray	Isle of Wight	1842	7	15	15	26	63	8 caudals added for the number concealed in the flukes.
Van Beneden	Borselaer	1869	7	15	14	25	61	
Lilljeborg	Coast of Norway	....	7	15	15	25	62	
Heddle	Laman Id.	1856	7	15	−4	o—	62	" Absolutely correct " (Heddle).
Struthers	Nairn	1884	7	15	15	25	62	
Delage	Langrune	1885	7	14	15	26	62	
Fischer	St. Vigor	1847	7	15	15	25	62	
"	St. Cyprien	1828	7	14	15	24 +	60 +	(+ 2 = 62)
Menge	Danzig	1874	7	15	14	24	60	
			AMERICAN.					
U. S. N. M. 16045	Cape Cod, Mass.	1876?	7	15	13	23 +	58 +	(+ 3 = 61)
Albany Mus.	" "	1880	7	15	14	26	62	
Rochester	Provincetown, "	1893	7	15	14	..	..	
Cambridge Mus.	" "	1880	7	16	14	26	63	
Boston Mus.	Gloucester "	1870	7	16	13	27	63	
Phila. Mus.	Sinepuxent Bay, Md.	1868–9	7	..	15	..	..	Type of *B. tectirostris*.
U. S. Nat. Mus.	Newfoundland	1901	7	16	14	25	62	Fœtus.

The most frequent formulæ for the cervical, dorsal, and lumbar vertebræ of European specimens shown by this revised table are: 7, 15, 14, and 7, 15, 15. A comparison with American specimens can scarcely be made with advantage as there are but six of these with complete formulæ as against eleven European specimens. The formulæ of two of the American specimens, however, agree with one of the two most frequent European formulæ above cited. In two other cases the American formula is 7, 16, 14. This might be considered as of some importance were it not that sixteen dorsals are indicated in two European specimens, as already noted on p. 136. A fifth American formula—7, 15, 13—is repeated in the Vlieland Id. skeleton, according to the interpretation of Flower.

On the whole, the facts regarding the vertebral formula do not appear to point to specific distinctness between European and American specimens, but the matter cannot be pronounced upon with entire satisfaction until more American specimens have been examined.

In Struthers's Nairn (Scotland) specimen the 2d and 3d pairs of ribs had capitular processes, or beaks; in Van Beneden's Borselaer specimen, the 1st and 2d pairs; in Heddle's Laman Id. specimen, the 2d, 3d, and 4th pairs. Other European specimens present still different combinations. In the American specimen in

the Museum of Comparative Zoölogy, Cambridge, Mass., the first three pairs of ribs have capitular processes; in the Gloucester (Mass.) specimen, the 2d and 3d pairs; in No. 16045, U. S. N. M., Cape Cod, Mass., the 2d, 3d, and 4th pairs.

In the type of *B. tectirostris* (Cope) the 1st rib is double-headed, as shown in pl. 4, fig. 4, and pl. 6, fig. 3. The rib is 30½ in. long (straight) to the middle point of the broad distal end; the breadth at the distal end, 7¼ in. The supplementary head is 6½ in. long in a straight line, and 2½ in. broad at the free end. A precisely similar first rib is described by Van Beneden as occurring in the Borselaer specimen (*4*, 27–30, fig.). This peculiarity was formerly considered of specific or even generic importance, but recent investigations, especially those of Sir Wm. Turner, lead to the conclusion that this conformation is properly to be regarded as an individual variation (see Turner, *Journ. Anat. and Phys.*, 5, 1871, pp. 348–361).

CHARACTERS OF VERTEBRÆ.

The number of vertebræ in *B. physalus* has already received attention (p. 134). The characters of the cervical vertebræ given by Flower in the diagnosis cited in a previous page (p. 131) are found in American specimens (see Dwight, *35*, 213–217, pl. 1, and this work, pl. 4, fig. 4, and pl. 5, fig. 1, type of *B. tectirostris* Cope). Struthers (*86*, 32) gives as characteristic of the 3d to the 7th cervicals of adult *B. physalus* the following:

3d and 4th. Transverse processes slanting obliquely backward.

5th. Transverse processes directed horizontally outward.

6th. Transverse process directed a little forward. Inferior transverse process usually more or less incomplete.

7th. Superior transverse process robust; inferior transverse process almost entirely absent.

These characters were found in the Gloucester (Mass.) specimen described by Dwight (*35*, 213, 217, figs. 5–7), and occur also in No. 16045, U. S. N. M., Cape Cod, Mass.

Among the characters of the caudal vertebræ which may be considered important are the positions in which the foramina and processes appear or disappear. Some of these points in European and American specimens are brought together in the following table:

BALÆNOPTERA PHYSALUS (L.). EUROPEAN AND AMERICAN. CHARACTERS OF VERTEBRÆ.

Character.	Falmouth, England, 1863, Flower.	St. Vigor, France, 1847, Fischer.	Langrune, France, 1885, Delage.	Danzig' Germany, 1874, Menge.	Gravesend, England, 1859, Murie.	Nairn, Scotland, 1884, Struthers.	(Mus. Comp. Zoöl., Cambridge, Mass.)	Gloucester, Mass., 1870, Dwight.	Cape Cod, Mass., 1880 (Albany).	Cape Cod, Mass., No. 16045 U. S. N. M.
Neural spine appears last on vertebra No.	—	52	51	51 (?)	51	50	51 or 52	52	51	50
Last distinct diapophysis on vertebra No.	—	50	51 (?)	49 (?)	51	48 or 49	49	49	—	48
First perforated diapophysis on vertebra No.	44	42	44 (?)	—	44	44	44	45	—	43
First complete inferior arterial foramen on vertebra No.	—	—	—	—	49	49	50	50	—	50

The European specimens show a substantial agreement in these characters with the American specimens and with each other, but in the case of the Borselaer skeleton, as reported by Van Beneden (*4*), the first vertebra with perforated transverse process is much farther back in the series than in other specimens. This striking peculiarity may perhaps be safely regarded as an individual variation.

CHEVRON BONES.

In *Balænoptera physalus* the series of chevrons begins anteriorly with a small bone, followed by a very large one, after which the bones decrease gradually in size to the posterior end of the series. Van Beneden made the following significant remarks in connection with the Borselaer skeleton: "The chevron bones are 21 in number; the last three of the caudal vertebræ are alone without them. We count among these bones the osseous rudiments visible in the cartilages, and which are very rarely preserved. Without particular attention, we should not have found in all but 15 of these bones" (*4*, 24.) There is little doubt that the series found in the majority of specimens in museums is incomplete, and the variations cannot, therefore, be relied upon in investigations of this kind. The numbers recorded in various European and American specimens are as follows:

BALÆNOPTERA PHYSALUS (L.). EUROPEAN AND AMERICAN. CHEVRONS.

European Specimens.			American Specimens.		
Locality.	No. of Chevrons.	Authority.	Locality.	No. of Chevrons.	Museum.
Borselaer (1869)	21	Van Beneden	Cape Cod, Mass.	15	Cambridge, Mass.
Falmouth (1863)	18[1]	Flower	Gloucester, "	16	Boston, "
Langrune (1885)	16[2]	Delage	Cape Cod, "	13	Albany, N. Y.
Gravesend (1859)	15	Murie	" "	14[3]	U.S. Nat. Mus., No. 16045.
Nairn (1884)	13	Struthers			

STERNUM.

In Flower's diagnosis quoted above (p. 131) the sternum is thus referred to: "Sternum broader than long, in the form of a short, broad cross, of which the posterior arm is very narrow; it might perhaps be compared to the heraldic trefoil; it is subject, however, to considerable individual variation."

In comparing figures of the sternum of European specimens, the variation at first appears excessive, but one soon perceives that much of it is due to differences in age. The figures brought together on pp. 140 and 141 show the sternum of various European and American specimens. (See text figs. 8 to 32.)

In the midst of this wide variation the sternum of immature individuals takes quite uniformly the form of a trefoil with short stem and wings, and deeply emarginate anterior border, as shown in the St. Vigor, Lofoten Ids., and Brussels Museum specimens. It also occurs in the National Museum specimens Nos. 16039 and

[1] "The chevron bones appear to be all present" (Flower).
[2] Thirteen well developed, the first small, the last two cartilaginous.
[3] The first large and hence probably preceded originally by a smaller one.

FIG. 8.

FIG. 9.

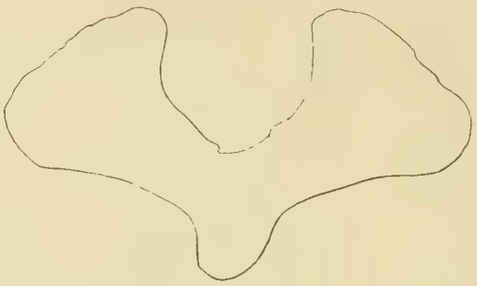


FIG. 10.

FIG. 11.

FIG. 12.

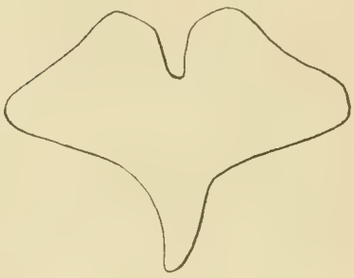


FIG. 13.

FIG. 14.

FIG. 15.

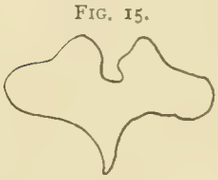


FIG. 17.

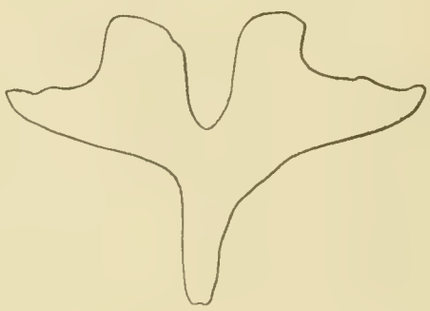


FIG. 16.

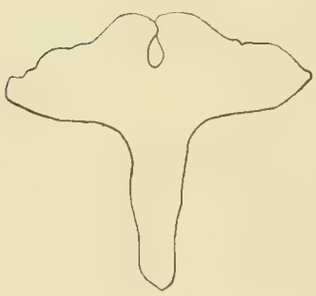


FIG. 18.

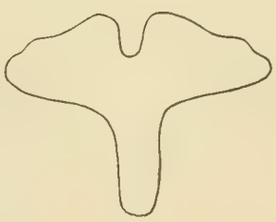


FIG. 19.

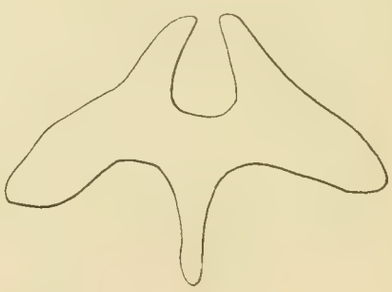


FIG. 20.

STERNUM OF *BALÆNOPTERA PHYSALUS* (L.).

FIG. 8.—CAPE COD, MASS. NO. 16039 U. S. N. M. IM. FIG. 9.—LOFOTEN IDS., NORWAY. IM. (FROM SARS.) FIG. 10.—CAPE COD, MASS. NO. 16045 U. S. N. M. IM. FIG. 11.—ST. VIGOR, FRANCE. JR. (FROM GERVAIS.) FIG. 12.—(BRUSSELS MUS.) JR. (FROM VAN BENEDEN.) FIG. 13.—FINMARK, NORWAY. AD. (FROM MALM.) FIG. 14.—ABBEVILLE, FRANCE. AD. (FROM GERVAIS.) FIG. 15.—CAYEUX, FRANCE. JR. (FROM FISCHER.) FIG. 16.—ROCHESTER, N. Y. AD. FIG. 17.—GROIX ID., FRANCE. AD. ♀ (FROM FISCHER.) FIG. 18.—LANGRUNE, FRANCE. AD. ♂ (FROM DELAGE.) FIG. 19.—(CHRISTIANIA MUS.) AD. (FROM SARS.) FIG. 20.—(ALBANY MUS., N. Y.) AD.

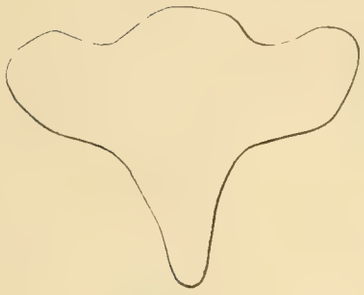


FIG. 21.

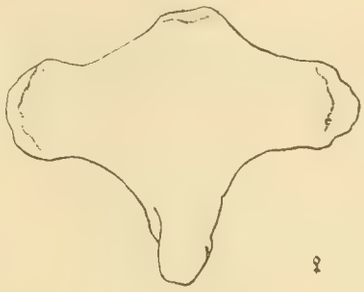


FIG. 22.

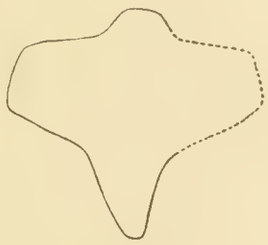


FIG. 23.

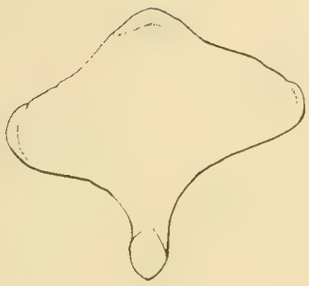


FIG. 24.

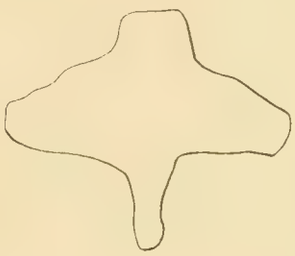


FIG. 25.

FIG. 26.

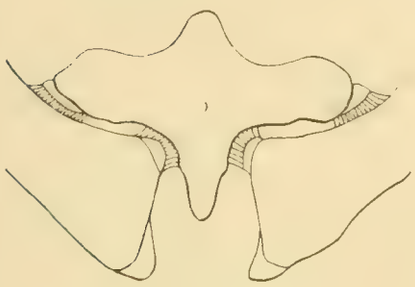


FIG. 27.

FIG. 28.

FIG. 32.

FIG. 29.

FIG. 30.

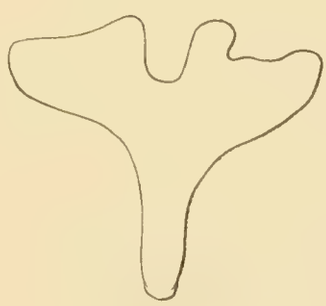


FIG. 31.

STERNUM OF *BALÆNOPTERA PHYSALUS* (L.).

FIG. 21.—VLIELAND ID., NETHERLANDS. AD. ♂ (FROM VAN BENEDEN.) FIG. 22.—HERAULT, FRANCE. AD. ♀ (FROM GERVAIS.) FIG. 23.—BORSELAER, NETHERLANDS. AD. (FROM VAN BENEDEN.) FIG. 24.—BAYONNE, FRANCE. AD. (FROM GERVAIS.) FIG. 25.—(CAMBRIDGE MUS., MASS.) AD. FIG. 26.—FALMOUTH, ENGLAND. AD. ♂ (FROM FLOWER.) FIG. 27.—PETERHEAD, SCOTLAND. AD. (FROM STRUTHERS.) FIG. 28.—ST. CYPRIEN, FRANCE. AD. ♂ (FROM FISCHER.) FIG. 29.—(BOSTON MUS., MASS.) IM. (FROM DWIGHT.) FIG. 30.—THE SAME, REVERSED. (FROM A SKETCH.) FIG. 31.—BORDIGHERA, ITALY. AD. (FROM GERVAIS.) FIG. 32.—CALIFORNIA. AD. (WISTAR INST., PHILA., *B. velifera?*)

16045 from Cape Cod, Mass. (See pl. 7, fig. 4.) The Cayeux specimen, cited by Fischer as young, appears to be exceptional in having the anterior border entire, with a vacuity below it, and the stem and wings scarcely differentiated. A close approximation to the normal form of the immature sternum is perpetuated in the adult in Malm's Finmark specimen, and Sars's Christiania Museum specimen. The latter leads to the more extraordinary adult form exhibited by the Groix Id., Albany (N. Y.) museum, Rochester (N. Y.) museum, and Langrune specimens, in which the anterior emargination is generally pronounced and the wings long and pointed. A quite different adult form is shown in the Vlieland Id., Herault, Borselaer (Schelde R.), Bayonne, and Cambridge (Mass.) museum specimens, in which the anterior border is convex, forming a fourth projection and converting the trefoil into a quatrefoil. This is carried to an extreme in Struthers's Peterhead specimen, in which the stem is aborted, and in the St. Cyprien specimen, in which the anterior portion is very large, with a straight margin and a vacuity within it. Finally, we have a variation in which the anterior and lateral limbs are merged together, as shown in the Falmouth and Cambridge (Mass.) museum specimens.

In all these variations the American specimens run parallel with the European ones.

FIG. 33. FIG. 35.

FIG. 34. FIG. 36.

SCAPULA OF *BALÆNOPTERA PHYSALUS* (L.). AMERICAN AND EUROPEAN.

FIG. 33.—LOFOTEN IDS., NORWAY. JR. (FROM SARS.) FIG. 34.—SINEPUXENT BAY, MARYLAND. IM. ♀ TYPE OF *B. tectirostris* (COPE). FIG. 35.—CAPE COD, MASS. IM. NO. 16039 U. S. N. M. FIG. 36.—CAPE COD, MASS. IM. NO. 16045 U. S. N. M.

PECTORAL LIMBS.

The figures of the scapula of *B. physalus* published by Malm (*65*, pl. 3, fig. 5) and Fischer (*44*, pl. 2, fig. 4) show the superior, or spinal, border quite evenly convex and the acromion low. These are probably incorrect, as Menge's photo-

graph (*69*) shows this bone as having the central part of the spinal border straight, the posterior part sharply bent downward, the anterior part somewhat so, and the acromion well raised above the level of the glenoid fossa. Sars's drawing (*77*, pl. 3, fig. 10) of a Lofoten Ids. specimen is intermediate between Menge's and those of Fischer and Malm. (See text fig. 33, p. 142.)

In the type of *B. tectirostris* (Cope) from Maryland (text fig. 35; pl. 6, fig. 2) the scapula is of the same form as shown in Menge's photograph of the Danzig specimen, as is that of the Cape Cod (Mass.) adult in the Albany museum, and the National Museum specimens Nos. 16039 and 16045, also from Cape Cod (text figs. 35 and 36; pl. 7, figs. 1 and 2). Dwight writes of the Gloucester (Mass.) specimen: "The superior border [of the scapula] is pretty regularly curved, *except that toward the last fourth it inclines rather suddenly downward*" (*35*, 222).

The greatest length of the scapula in three adult European specimens is 27.6 % of the length of the skull. In the Albany museum (N. Y.) adult it is 27.9 %, and in three immature American specimens 25.3 %. In two European specimens the radius is 17.2 % the length of the skull, and in two American specimens 17.5 %.

The number of phalanges found in specimens mounted in museums is commonly reduced from the natural number by the loss of one or more pieces in the process of maceration to remove the flesh. The numbers included in the following table are probably quite complete. Those quoted from Struthers and Dwight represent their own dissections. The metacarpals are excluded:

BALÆNOPTERA PHYSALUS (L.). EUROPEAN AND AMERICAN. PHALANGES.

Locality.	Authority.	Length.	II.	III.	IV	V.	Carpals.	Remarks.
		ft. in.						
St. Cyprien, France...	Fischer.	84 0	4	6	5	4 (or 5)	6[1]	
Wick, Scotland.....	Struthers.	65 to 66	4	7	7	4	.....	Aged.
Peterhead, Scotland...	"	64 0	3	6	5	3	5	
(Albany Mus., N. Y.)...	F. W. T.	63 0	4	6	5	3	.....	
(Cambridge Mus., Mass.).....	Lucas.	.....	3	6	5	3	.....	
Stornoway, Scotland...	Struthers.	60 6	4	6	5	3	.....	
Borselaer, Netherl....	Van Beneden.	55 9	2	5	5	3	5	
Nairn, Scotland.....	Struthers.	50 0	3	6	5	3	.....	
Gloucester, Mass.....	Dwight.	48 0	4	6	4	2	6[2]	
Lofoten Ids., Norway...	Sars.	40 8[3]	3	5	5	4	5	
	Weber.	.....	3	6	5	3	.....	
	Macalister.	.....	4	5	6	3	.....	
Capo Vado, Italy.....	Camerano.	.....	4	6	6	3	.....	
Langrune, France.....	Delage.	.....	3	6	6	2[4]	.....	
	Kükenthal.	.....	4	7	7	3	.....	Embryo, 38 cm. long.
	"	.....	4	7	7	3	.....	" 49 " "
	"	.....	3	7	6	3	.....	" 58 " "[5]

[1] Doubtless includes the ossified pisiform cartilage.

[2] Includes the pisiform cartilage. The formula is for the left side. The right side had the following: II., 4; III., 6; IV., 5; V., 2. [3] Norwegian measure. [4] Plus one "encore cartilagineuse."

[5] Kükenthal's formulæ include one more phalanx in each digit than given above, but it is obvious from his figures that the metacarpals are included. His remark, that these specimens confirm the law that more phalanges are present in the embryo than in the adult, does not, therefore, hold good when Struthers's Wick (Scotland) specimen is considered. (*Anatom. Anzeig.*, 5, 1890, pp. 50, 51.)

The most frequent formula for mature individuals, or those above sixty feet, appears to be—II., 4; III., 6; IV., 5; V., 3. The Albany (New York) and Stornoway (Scotland) specimens have this formula. The Gloucester (Massachusetts) specimen is the same on the right side, except that the fifth finger has one less phalanx. There is, therefore, no ground for the specific separation of American and European specimens on the basis of the segmentation of the digits.

PROPORTIONS OF THE SKELETON.

The number of European skeletons of *B. physalus* of which there are detailed measurements on record is not so large as one might expect, considering the numerous instances in which specimens have stranded on that side of the Atlantic. Companyo's Monographie Illustrée is not accessible to me, but I have consulted the data furnished by Flower, Murie, Sars, Van Beneden, Struthers, Malm, and others. Such of the measurements of different specimens as are comparable are reduced to percentages of the length of the skull, and brought together in the following table, with similar measurements of some American specimens, including the type of *B. tectirostris* (Cope):

BALÆNOPTERA PHYSALUS (L.). EUROPEAN AND AMERICAN. SKELETON.

	Falmouth, Eng. Alexandra Park. (Flower, 1869.)	Vlieland Id, Netherl. Antwerp Gardens. (Flower, 1864.)	Finmark Skeleton. (Malm, 1868.)	Gravesend, Eng. Rosherville Gardens. (Murie, 1865.)	Nairn, Scotland. (Struthers, 1889.)	*Balænoptera* sp.? California. Wistar Inst., Phila.	Rochester, N. Y. Ward's Nat. Sci Estab.	Gloucester, Mass. (Dwight, 1872.)	16045, U. S. N. M. Cape Cod, Mass. Skeleton mounted.	Type of *B. tectirostris* (Cope).
Sex and age	♂ ad.	♂ ad.	.....	♂ ad.	♂	ad.	ad.	♀	jr.	.....
Total length of whale	.....	72′ 2″	.....	60′ 0″	50′ 0″	68′ 0″	.....	48′ 0″	.....	47′ to 48′ [1]
" " " skeleton	66 0 [1]	67 6″	60 10½″	.....	.....	62 10 +	.....	.....	45′ 7″ [2]	45′ 7″ ±
Length of skull (straight)	186″	184″	180″	168″	145.0″	192.0″ [3]	189.5″	144″	125″	121″
	%	%	%	%	%	%	%	%	%	%
Greatest breadth of axis	23.1	24.0	.....	25.0	20.5	.....	23.2	20.3	20.4	20.7
Depth of body of axis	.....	.....	.....	5.4	4.4	.....	4.8	4.6	4.8	5.8
Greatest breadth 1st dorsal	.....	.....	.....	19.0	18.4	.....	17.4	18.0	18.1	18.8
Depth centrum 1st dorsal	.....	.....	4.5	4.4	5.2	.....	4.7	5.2	5.8	6.0
Greatest breadth 1st lumbar	.....	....	23.9	22.3 [4]	24.6 [4]	.....	22.2	23.5	25.6	26.5
Depth centrum 1st lumbar	.....	.....	5.1	5.2 [4]	6.0 [4]	.....	5.5	5.9	6.2	6.4
Greatest breadth 1st caudal	.....	.....	16.4 [5]	16.6 [6]	16.9 [6]	.....	.....	16.1 [7]	19.2 [8]	.....
Depth centrum 1st caudal	.....	.....	6.4	6.8	7.0	.....	.....	6.8	7.6	7.6
Greatest length of sternum	11.2	10.3	.....	10.1	8.3	.....	8.9	8.9	7.2	.....
" breadth " "	13.0	13.1	.....	13.1	12.6	.....	13.9	10.9 [9]	12.0	.....
" " " scapula	27.4	28.0	.....	27.9	27.0	26.0	27.9	24.1	25.6	27.1
" depth " "	15.6	16.8	15.9	16.1	15.5	16.1	16.4	14.3	16.0	16.1
Length of radius	17.0	17.4	.....	.....	17.9	17.5	17.4	16.2	17.6	19.9
" " ulna (*extreme*)	19.3	19.6	.....	.....	18.6 [10]	18.5	19.0	18.0	18.4	18.4

[1] Straight.
[2] 7 inches are added for last 3 caudals, which are probably missing.
[3] 5½ in. added for premaxillæ.
[4] 2d lumbar.
[5] Vert. No. 38.
[6] This is the 38th vert.; the 36th = 19.0 %.
[7] This is the 38th vert.; the 36th = 18.4 %.
[8] Vert. No. 36.
[9] Broken.
[10] 2⅛ inches added for olecranon.

The agreement of the various measurements is, on the whole, a close one, and where discrepancies appear there is no evidence of a constant difference between European and American specimens. Dwight's specimen from Gloucester, Mass., according to his measurements, has a smaller scapula than any other specimen, while the type of *B. tectirostris* has a longer radius. The same differences do not obtain in the other two American specimens. They may be individual or due to a difference in the manner of taking the measurements. In the case of Dwight's Gloucester (Mass.) specimen, the short radius indicated by the measurements is not found in figure 12, plate 6, of his article.

Much more significant than these differences is the agreement between Dwight's specimen and that from Nairn, Scotland, measured by Prof. Struthers (*88*, 330). The proportions of the vertebræ are practically identical; the difference in the size of the scapula, as already stated, is not confirmed by the other American specimens.

SUMMARY.

The consideration of the various external and osteological characters of *Balænoptera physalus* and of American specimens resembling that species has now been completed as far as circumstances will permit. While numerous discrepancies have been detected in individual cases, the evidence as a whole points unmistakably, in my opinion, to the conclusion that the same species occurs on both sides of the Atlantic, and I believe that with further investigation and fuller data the discrepancies which have been pointed out will be found to rest on individual or sex variation, or lack of conformity in measurements.

One point, however, appears to me to be worthy of special attention: The maximum and average total length of both sexes is less for Newfoundland specimens than for those taken at the Norwegian whaling stations in Finmark, or captured or stranded on other parts of the European coasts.

It is somewhat difficult to determine the importance and real meaning of this apparent difference in size. Three alternatives suggest themselves. It may be (1) a real difference; or (2) it may be due to an exaggeration of the measurements by the Norwegian whalers; or (3) it may arise from the fact that the Norwegian and Newfoundland whales belong to the same herds, and that the largest individuals have been killed. As to the second alternative, it has to be said that while the measurement may be exaggerated there is no evidence that such is the case. The third point is of more importance. The Norwegian measurements quoted from Cocks were for whales captured off Finmark between 1885 and 1886, a decade before the Newfoundland fishery began. There was ample time for the largest individuals to be killed off. But it is necessary to prove that the herds of the eastern and western Atlantic mingle together. The present evidence of such a commingling cannot be considered conclusive. Hence, the difference in size between the Norwegian and American individuals still has validity. It cannot by itself, however, be considered as proof of specific distinctness, as it is quite allowable to suppose that there may be separate herds belonging

to the same species in which the average of size is different. This view seems most reasonable in the case in question, considering the remarkable correspondence in proportions and other characters.

To my mind, the demonstration of the specific identity of the "Common Finback" of the eastern and western Atlantic in the foregoing pages is practically complete. That the average size of the specimens taken on the two sides of the ocean does not agree, is a matter to be explained hereafter, but standing by itself it does not, I think, invalidate the demonstration.

THE REPRESENTATIVE OF *B. PHYSALUS* IN GREENLAND.

Robert Brown and others have stated that the Greenlanders recognize two or more species of large Finbacks under the name of *Tunnolik*. There appears not to have been as yet an opportunity for a zoölogist to treat the matter critically on the basis of specimens of different kinds actually examined and compared, but cetological literature contains some few data bearing upon the subject.

Scoresby gives a few measurements and a brief description of a "Physalis found dead in Davis's Strait, 105 feet" long (*84*, i., p. 481). This is more likely to have represented an American Sulphurbottom than *B. physalus* (L.), although the length is no doubt exaggerated. Eschricht gives measurements of a *Tunnolik* which H. P. C. Möller examined in 1843, but this was also probably a Sulphurbottom.

In his Översigt af Skandinaviens Hvaldjur, Lilljeborg (*64*, 47 and 55) gives a few measurements of, and some notes on, a skeleton from Greenland in the Copenhagen museum, which is probably to be regarded as representing *B. physalus*. The description is as follows:

"The skeleton is from a young animal, with loose vertebral epiphyses and with the outer parts of the annular transverse processes of the 3d to the 6th cervical vertebra cartilaginous. The number of vertebræ is 61, of which 24 are caudal vertebræ. All the lumbars, as well as the posterior dorsals, are keeled along the under side of the body, though the keel is least marked anteriorly. The 13 anterior caudals do not decrease largely in length backward. The transverse processes of the most posterior dorsals are with rounded terminations, and also that of the 1st lumbar, and are also directed a little backward, whereas, on the contrary, the latter are directed forward. The transverse processes of the 6 anterior dorsals are directed forward, the most anterior the most strongly, and that of the 6th little marked, but still so that the line drawn from the middle of the tip of one to the same place on the other lies in front of the middle of the body of the vertebra. The transverse processes of the 7 posterior dorsals are directed backward, but of these the first and last less strongly. The transverse processes of the 7th and 8th dorsals are directed straight out on the sides. All the transverse processes of the lumbosacrals, with exception of the last, are, however, directed forward. Processus spinosi inferiores 18."

The characters of the vertebræ above given agree with those of the Massachusetts skeleton in the National Museum, but in the latter the anterior dorsals

are only very slightly keeled below. The number of chevrons cited by Lilljeborg is two more than in any American specimen of *B. physalus* I have examined, but Flower's Falmouth (Eng.) specimen had the same number as the Greenland skeleton, as will be seen by reference to p. 139.

Lilljeborg's measurements are as follows:

BALÆNOPTERA PHYSALUS. GREENLAND. SKELETON.

Measurement.	Greenland. (Copenhagen Museum.)[1]
	ft. in.
Length of skeleton	53 0
" " mandible	13′ to 14′
Periphery of mandible at the middle	2 3
Length of body of first lumbar	0 9
Breadth of body of first lumbar	0 11 5/8
Length of transverse process of first lumbar	1 2 3/8
" " body of fifteenth lumbar	0 11 1/8
Breadth of body of fifteenth lumbar	1 0 5/8
Length of body of first caudal	0 11
Breadth of body of first caudal	1 1
Length of body of third caudal	0 11 1/8
Breadth of body of third caudal	1 0 1/8
Length of transverse process of third caudal	0 5 3/8
Breadth of transverse process of third caudal	0 6 3/4
Distance between outer angles of processus obliqui of third caudal	0 4 3/4
Length of neural spine of third caudal	0 10 1/4
" " body of fifth caudal	0 11 1/2
Breadth of body of fifth caudal	1 1 1/2
Length of last caudal	0 1
" " sternum	1 3 1/2
Breadth of sternum	1 8 1/2
Length of first rib	3 9 1/2
" " scapula from glenoid cavity to the opposite upper border	2 0
Breadth ditto	3 7 1/4
Length of acromion	0 11 1/2
" " humerus	1 7 1/4
" " ulna to tip of olecranon	2 4 7/8
" " radius	2 3 5/8
" " one pectoral limb from head of humerus	6 7 1/4

OPINIONS OF EUROPEAN CETOLOGISTS REGARDING THE OCCURRENCE OF *B. PHYSALUS* IN AMERICAN WATERS.

In the Ostéographie (*8*, 236) Van Beneden and Gervais express the opinion that Cope's *Sibbaldius tectirostris* is probably the same as *B. physalus* (for which they use the name *B. musculus*), but they had not seen the type, nor did they enter into any discussion of the subject. In 1889, again, Van Beneden includes Greenland in the range of this species, probably on the basis of the observations of Fabricius (*7*, 224), and remarks, "various authors have reported it at New England," referring doubtless to the observations of Dudley, Cope, and Allen.

[1] Swedish measure.

In the work previously cited (*8*, 171), Van Beneden and Gervais seem to regard the species described by Holböll under the Eskimo name *Kiporkarnak* as probably representing this species, but Eschricht was in doubt as to this, and certainly Holböll's description is not favorable to this view. It is in part as follows:

"Above on the head it had many rows of high tubercles of rounded form, 3 to 4 in. broad, and perhaps as high. They were located at equal distances from each other; hence, in rows. . . . The furrows on the neck and breast reach about as far back as in *B. longimana* [*Megaptera*], but stand much wider apart. The pectorals, which must be regarded as long, were, however, shorter than in *B. longimana*. They are quite narrow, and have some irregular emarginations, one large emargination is to be seen about in the middle. . . . The color is whale,—black on the back and on the sides, white on the belly; the underside of the pectorals and flukes white, on the latter with a black band." (*37*, 197.)

It is clear, I think, that this was a Humpback and not a Finback whale. Eschricht states that Holböll saw this whale only from the deck of a vessel, and asks very pertinently how he knew that it was the same as the *Kiporkarnak* of the Eskimos. Fabricius, doubtless, employed this native name correctly, and certainly for a very different animal from that described by Holböll, as above.

CHAPTER V.

THE SULPHURBOTTOM, *BALÆNOPTERA MUSCULUS* (LINN.).

The characters of the Sulphurbottom or Blue whale, the largest of the Finbacks and of all living animals, have been set forth with exactness in the writings of Sars (*78* and *79*), Collett (*20*), Hallas (*60*), and Reinhardt (*75*). That a similar or identical species frequents the Atlantic coast of North America has been known for a long time, but specimens have very rarely found their way into American museums, and exact observations on its external characters are equally hard to find. Fortunately, at the new southern station of the Cabot Steam Whaling Company, Newfoundland, Sulphurbottoms are taken in large numbers, and I had opportunities in the summer of 1901 to make a careful examination of numerous specimens.

The characters ascribed to *B. musculus* by Sars are as follows (*79*, 18):

"The length of full-grown individuals is 90 feet [Norwegian]; and it is not improbable that it may extend to 100 feet, so that this whale is to be regarded as the giant of all animals now living.

"The body is less slender than in the ordinary Finbacks [*B. physalus*], but not quite so thick-set as in the Little Piked whale [*B. acuto-rostrata*]. The greatest depth is contained about $5\frac{1}{2}$ times in the total length, and the body behind the navel decreases in size gradually to the root of the flukes.

"The color is everywhere, as well on the back as on the belly, uniform gray-blue, sometimes lighter, sometimes darker.

"On the pectoral region is generally found a larger or smaller number of small milk-white spots.

"The length of the mouth is quite great, as in full-grown individuals it may be contained in the total length about $4\frac{1}{2}$ times. The upper jaw, seen from above, is proportionately much broader than in the two preceding species [*B. physalus* and *B. acuto-rostrata*], as it begins first to decrease in breadth at the middle of the length, so that the margins are quite strongly rounded and the snout rather blunt.

"Pectoral fins proportionately larger than in the other species of the genus, but generally not more than $\frac{1}{7}$ the total length. Their form is somewhat different, in that they are more falcate, with the hind angle lying anterior to the middle of the length of the fin. On the outer side they are of the color of the body; on the inner side and along the whole anterior convex margin, pure white.

"Dorsal fin extremely small and thin, triangular, and lies far back, at the beginning of the last fourth of the length of the body, and a good deal behind a vertical line drawn through the anus.

"Flukes about the same color on the lower side as on the upper, or a little lighter.

"Whalebone all dark blue-black."

SIZE.

As we see above, Sars gives the length of *B. musculus* as 90 ft. (Norwegian),[1] but expresses the opinion that it may extend to 100 ft. (Norwegian)[2] in some cases. In 1877, Collett remarked of the species (*20*, 161):

"The usual length of the Blue whale is about 72 ft. 2 in.[3] (22 m.); while individuals are frequently caught that are barely 65 ft. 7 in. (20 m.), sometimes specimens are obtained which are between 81 ft. 8 in. and 91 ft. 10 in. (28 m.) in length. On a single occasion Foyn observed from his boat an individual whose length he estimated at 132 ft. 10 in. (40½ m.), but as he had another in tow at the time he could not attack this giant.[4] Three of the individuals investigated by me in 1874 had a length of between 72 ft. 2 in. and 81 ft. 8 in. The females appear as a rule to be larger than the males."

Sophus Hallas measured six specimens in Iceland in 1867 (*60*, 176), the largest of which, a male, was 80 feet (Danish) from the tip of the upper jaw to the notch of the flukes, measured along the curves.

Cocks has given measurements of the total length of numerous specimens taken at the Finmark stations (*15* to *19*). He remarks (*15*, 17, sep.):

"I was told, at third hand, of a Blue whale which measured 102 ft., and similar stories are numerous; but I doubt if the whales were in any case accurately measured. Dr. Guldberg does not believe it ever attains a length of 100 ft.; a little over 80 ft. is, I believe, the longest that has been at all accurately measured at Vardö, and whales of this length are the exception. Dr. Guldberg (*Vardö Posten*, Sept. 2, 1883) says of this species: 'Its length varies between 70 and 80 ft.; the individuals that are 70 ft. and under, I have always found to be rather young, and not full-grown. That it can attain to a length of over 80 ft. is certainly unquestionable, although it may be very seldom. But the numerous measurements which have been taken of various individuals are not trustworthy, since they are not measured in a right line from the point of the under jaw to the cleft in the tail fin.'"[5]

In his reports on the fishery seasons of 1885 and 1886, Cocks gives measurements of numerous specimens of the Blue whale (*17* and *18*). The largest of these is 87 ft. 7 in. (85 feet, Norwegian).

In 1886 Guldberg, in a valuable paper on the biology of the North Atlantic Finback whales (*57*, 164), confirmed and extended his observations on the size of

[1] Equals 92 ft. 8 in., English.

[2] Equals 103 feet, English.

[3] The measurements given in feet in the original I have translated into *English* feet and inches for convenience.—F. W. T.

[4] The fact of having a whale in tow would not have hindered Captain Bull of the Newfoundland station from attacking a second individual, however large. He frequently brought in two at a time.

[5] Guldberg's measurements are, no doubt, Norwegian, so that his statement should read: It varies between 72 ft. 1 in. and 82 ft. 5 in., English. Individuals 72 ft. 1 in., English, and under are young, etc.

B. musculus. His remarks are so important in the present connection that a translation of the pertinent paragraphs of his article will be given. He writes:

"It is well known that this whale grows to a great size. The excessive length of 102 ft. 8 in.[1] and more has, indeed, been given. Collett states that Commander Sv. Foyn told him that he had once seen from his ship a gigantic example, whose length he estimated at 132 ft. 10 in. (40½ m.). I can not, however, refrain from expressing strong doubt that such large individuals exist. I shall not believe in such excessive size until I am convinced by correct measurements. Without wishing to decry the practical exercise of estimating with the eye the size of objects at sea, I have seen cases enough in which the most experienced seamen have at times been deceived, when observations at great distances were concerned.

"During my last voyage to Finmark in 1883 a very accurate whaler mentioned to me that he had seen a Blue whale 102 ft. 8 in. long which was driven to land on the Murman coast. He had not, however, measured the specimen! Prof. Collett states that the usual length is 72 ft. 2 in. I believe, however, that this is estimated too low.

"In his last article (in *P. Z. S.*, April, 1886) he places the length between 70 and 80 feet, which measure I can confirm. Prof. Sars (in *Forh. Vid.-Selsk.*, Christiania, 1878) estimates the length of the full-grown animal at 92 ft. 8 in. This seems to me set too high. I have prepared the skeleton of many Blue whales. The first skeleton, a male nearly 78 ft. 9 in. (24 m.) long, was taken to the University of Christiania in 1881 and later the fat was removed, at least from the vertebræ. It showed that all the epiphyses were anchylosed to the bodies of the vertebræ. In 1882 I directed the preparation of a Blue whale (about 22 m.) which is in the Royal Museum at Brussels; in the year 1885 I prepared skeletons of two examples, which were somewhat smaller, the one 22.27 m. and the other about 21.17 m. A full growth was not shown here. I am on that account disposed to accept 77 ft. 1 in. (23½ m.) as a minimum for the adult animal.

"As regards the maximum, it is, of course, impossible to say anything with certainty. I will not dispute a length of 92 ft. 8 in., although I believe that it very seldom occurs. The largest individual that I have measured was 84 Norwegian feet [= 86 ft. 6 in. English], or about 26½ m., long; it was shot at sea under my eyes by the boat *Jarfjord.* Prof. Aurivillius and Dr. Forstand of Upsala measured in 1878 an example 86 ft. long,[2] and Collett states that in 1868 a Blue whale 96 feet long[3] was found dead at sea and towed into Vardö. The Blue whales which I have seen varied mostly between 72 ft. 1 in. and 82 ft. 5 in. When an animal measured more than 77 ft. 3 in. or 78 ft. 3 in., it was considered quite large by the whalers."

The largest recorded measurement for the species is that given by Dubar (*34*, 17) for the Ostend whale, namely, 31 meters, or 101 ft. 8 in. This is probably erroneous. In his introduction, Dubar (*34*, 5) alludes to the same specimen as being 95 ft. long, while Van Breda (*11*, 344) and Nyenhuis (*71*, 166) cite it as 25 ells, or 80 ft. (Dutch) long. Van Beneden mentions the length in various places

[1] In the translation the feet are reduced to feet and inches English measure.

[2] Kind of feet not mentioned. If Norwegian, would equal 88 ft. 7 in. English.

[3] Probably Norwegian feet (though Guldberg does not say so), in which case it equals 98 ft. 11 in., English.

as between 80 ft. and 85 ft. In view of this uncertainty, to which Turner (*91*, 244) has already called attention, the Ostend specimen can scarcely be cited as representing the maximum length, though there is no doubt it was a thoroughly adult, or old, individual. A specimen 30 meters long, or 98 ft. 4 in., is mentioned by Fischer (*44*, 72) as stranded at Dunquerque, in 1863. No particulars are given. The bibliographic reference is to Fredol's Le Monde de la Mer, a book with which I am not acquainted. Beauregard gives the same length, 30 m., for a male stranded at Oessant, France, in Feb., 1893 (*Comp. rend. Soc. Biol.* (9) 5, 1893, 274).

Another very large measurement is that of Scoresby (*84*, i., p. 482), for a specimen stranded in the Humber River, in 1750. The length recorded is 101 feet. So far as I am aware, this is not verified. The North Berwick specimen, described by Knox (*62*), is said by him to have been 78 ft. in a straight line from the snout to the notch of the flukes, but he adds that "if the line had been passed along the surface of the body, following its flexuosity, the whole length would have been from 90 to 95 feet," a statement which may perhaps be properly questioned.

Sars remarked in 1874 (*78*, 7, sep.): "The largest example I had opportunity to see was fully 80 feet[1] long in a straight line." This statement is indefinite. A specimen of this species, figured and described by Van Beneden (*7*, 257) from notes furnished by Dr. Otto Finsch, is given a length of 86 feet. It was a female, and was captured near Vadsö, East Finmark, July 7, 1873. Whether the measurement is French or German is not stated; if the latter, it would amount to 88 ft. 7 in. English measure.

The length of the Longniddry (Scotland) whale, according to Sir Wm. Turner (*91*, 199), was 78 ft. 9 in. "along the middle line of the back, from the tip of the lower jaw to the end of the tail." As the lower jaw projected 1½ ft. beyond the upper, the length from the tip of the snout would be 77 ft. 3 in. The expression "end of the tail," as shown by the context, means the notch of the flukes.

From the foregoing records it appears that the largest reliable measurements are those given by the Scandinavian zoölogists and by Dr. Otto Finsch. The measurement by Aurivillius and Forstand, if in Norwegian feet, represents the maximum. This is 86 feet, which, if Norwegian, equals 88 ft. 7 in., English measure. Dr. Finsch's Vadsö specimen, if the measurement was in Rheinland feet, was of the same length, 88 ft. 7 in., English measure. Next follows Guldberg's specimen—84 feet Norwegian, which equals 86 ft. 6 in., English measure. The largest of the whaler's measurements cited by Cocks is 85 ft. Norwegian, which equals 87 ft. 6½ in., English measure (*17*, 7, sep.).

It has to be said of all these measurements that they can only be regarded as approximate, as it is not definitely stated whether they are from the tip of the upper or the lower jaw, from the notch or the border of the flukes, along the curves or in straight lines.

The total length and the sex of specimens taken at Balena station, Newfoundland, in the summer of 1901, and measured by myself, with the assistance of Dr. D. W. Prentiss, were as follows:

[1] Equals 82 ft. 5 in., English.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND.

Capture No.	Date of Capture.	Sex.	Total Length.[1]
(1) 1	June 20	♀	72 ft. 0 in.
(2) 2	" "	♂	71 " 0 "
(3) 3	" 21	♀	73 " 10 "
(4) 4	" 22	♀	73 " 6 "
(5) 5	" "	♂	68 " 3 "
(6) 6	" 24	♂	65 " 0 "
(7) 7	" 25	♂	67 " 0 "
(8) 8	" "	♀	61 " 0 "
(9) 9	" 26	♀	72 " 0 "
(10) 10	" 27	♂	72 " 7 "
(11) 11	" "	♂	71 " 6 "
(12) 12	" 28	♀	66 " 6 "
(13) 13	" "	♂	65 " 11 "
(14) 14	" 29	♀	77 " 2 "
(15) 15	" "	♂	63 " 6 "
(16) 17	July 2	♂	65 " 8 "
(17) 18	" 3	♂	72 " 2 "
(18) 19	" 4	♀	74 " 6 "
(19) 20	" "	♀	70 " 3 "
(20) 21	" 5	♂	65 " 2 "
(21) 22	" 6	♀	61 " 3 "
(22) 23	" "	♀	67 " 3 "
(23) 24	" 8	♀	61 " 2 "
(24) 25	" "	♀	69 " 6 "
(25) 26	" "	♀	65 " 8 "

The males and females in order of size were as follows:

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND.

Males.	Females.
72 ft. 7 in.	[2]77 ft. 2 in.
72 " 2 "	[2]74 " 6 "
71 " 6 "	73 " 10 "
71 " 0 "	73 " 6 "
68 " 3 "	72 " 0 "
67 " 0 "	72 " 0 "
65 " 11 "	70 " 3 "
65 " 8 "	69 " 6 "
65 " 0 "	67 " 3 "
63 " 6 "	66 " 6 "
	65 " 8 "
	65 " 2 "
	61 " 3 "
	61 " 2 "
	61 " 0 "
Maximum..... 72 ft. 7 in.	77 ft. 2 in.
Minimum..... 63 " 6 "	61 " 0 "
Average..... (10) 68 " 3 "	(15) 68 " 9 "

[1] The total length is from the tip of the upper jaw to the notch of the flukes, measured along the curve of the back.

[2] Contained a fœtus.

From Cocks we obtain the following statistics of 36 specimens taken at the Norwegian stations (*17* and *18*):

BALÆNOPTERA MUSCULUS (L.). NORWAY.

	Males.	Females.
Maximum	85 ft. 0 in.	87 ft. 6½ in.
Minimum	51 " 0 "	52 " 0 "
Average	(36) 74 " 0 "	(36) 75 " 8 "

On comparing these figures with the previous ones, it will be observed that the Norwegian whales, both males and females, appear to attain a greater length than those of Newfoundland. The average length is also greater, though the computation includes individuals smaller than any of the Newfoundland specimens. Before my arrival at Balena station, Newfoundland, in 1901, and also in the preceding year, a number of Sulphurbottom whales had been taken. Adding such of the measurements of these as are available to my own, the following figures are obtained:

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND.

	Males.	Females.
Maximum	81 ft. 0 in.	79 ft. 0 in.
Minimum	63 " 0 "	55 " 0 "
Average	(57) 70 " 8 "	(35) 70 " 0 "

Though a higher general average is obtained in this way, the maximum and average for females are a little less than for males. This is due to the fact that many comparatively small females and few very large ones were taken in the summer of 1900.

Averages obtained in this way, as already remarked in treating of *B. physalus*, are not satisfactory on account of the inclusion of immature individuals. The best way to get rid of these, in the case of the females at least, will be to omit from consideration all specimens having a length less than that of such as are ascertained to be sexually mature. Guldberg, as we have seen (*15*, 17, sep.), remarked of the Norwegian specimens, "the individuals that are 70 ft.[1] and under I have always found to be rather young and not full-grown." He also remarked (*57*, 164): "It is not easy to fix the minimum for gravid females. I am, however, inclined to fix the minimum at 70 feet [= 72 ft. 1 in., English measure], and to estimate the average at about 75 feet [23½ m.][2] or more." Of the Norwegian females cited by Cocks as containing fœtuses, or having milk running, the smallest is 74 feet 2 in. Of the females taken at Balena station, Newfoundland, 1901, the following females observed by myself contained fœtuses:

[1] Norwegian feet; equals 72 ft. 1 in., English measure. [2] 77 ft. 1 in., English measure.

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND. FŒTUSES. 1901.

Capture No.	Date.	Length of Adult.	Length of Fœtus.	Sex of Fœtus.
No. 1	June 20	72 ft. 0 in.	3 ft. 1 in.	♀
No. 14	" 29	77 " 2 "	3 " 8½ "	♀
No. 19	July 4	74 " 6 "	3 " 6½ "	♀

Of the specimens obtained at the same station in 1900, the following females contained fœtuses:

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND. FŒTUSES, 1900.

Capture No.	Date.	Length of Adult.	Length of Fœtus.
No. 54	May 31	73 ft.	7 ft.
No. 99	July 10	73 "	13 "

From the foregoing data, it appears that the minimum length at maturity is 72 feet for females. Excluding all below that length, the average for southern Newfoundland, fourteen specimens, is 74 ft. 8½ in.

For the Norwegian specimens, employing the same minimum, we obtain (24 specimens) 79 ft. 3 in. as the average total length.

It is to be observed in this connection that the Longniddry whale, which was 78 ft. 9 in. long from the tip of the lower jaw to the notch of the flukes, and contained a fœtus, is classed by Sir Wm. Turner (*91*, 203) as "adolescent," in accordance with Flower's system (*45*, 385), based on the condition of the epiphyses of the bones. It is well known that in many species of mammals offspring are produced before the skeleton of the parent is completely ossified, but it may perhaps be questioned whether in whales the total length increases materially after sexual maturity.

The condition of the bones cannot be ascertained usually at a whaling station, where the carcasses are towed away as soon as the blubber is stripped off. It is probable, however, that the size at which sexual maturity is attained is quite as constant as the size at which the skeleton is completely ossified, so that averages based on specimens known to be sexually mature may be regarded as reliable and useful. Under the ordinary conditions of observation this is not as readily ascertained for males as for females. As the males in this genus are smaller than the females, we shall have too high an average for the former by excluding all individuals below the length of the latter at sexual maturity. The amount, however, is not likely to be large and may be neglected.

For males 72 feet long and above, the average of the specimens measured by myself at Balena station, Newfoundland, in 1901, is 72 ft. 4½ in. (2 specimens). Including the specimens taken the previous year at the same station, the average is 75 ft. 1 in. (19 specimens). For the Norwegian males cited by Cocks, the average is 77 ft. 7½ in. (27 specimens). The following table sums up these various statistics:

BALÆNOPTERA MUSCULUS (L.). AMERICAN AND EUROPEAN.

Locality.	Average for all Specimens of both Sexes.		Average for all Females.		Average for all Males.		Average for Mature Females [1]		Average for Mature Males. [1]		Maximum for Females.	Maximum for Males.	Minimum for Females.	Minimum for Males.
	No.	Length.	No.	Length.	No.	Length.	No.	Length.	No.	Length.	Length.	Length.	Length.	Length.
Newfoundland (Balena station) Season of 1901 (my measurements) .	25	68′ 6″	15	68′ 9″	10	68′ 3″	6	73′ 10″	2	72′ 5″	77′ 2″	72′ 7″	61′ 0″	63′ 6″
Season of 1901, all specimens	71	71′ 3″	...	.....	...	.....	...	.....	...	.....	(82′, sex unknown)		61′ 0″	63′ 6″
Season of 1900, all specimens	67	71′ 10″	19	70′ 11″	48	71′ 2″	8	75′ 5″	17	75′ 5″	79′ 0″	81′ 0″	55′ 0″	63′ 0″
All the foregoing Newfoundland specimens	138	71′ 7″	...	.....	...	.....	...	.....	...	.....	(82′, sex unknown)		55′ 0″	63′ 0″
Norway (Cocks) . .	72	74′ 10″	36	75′ 8″	36	74′ 0″	24	79′ 3″	27	77′ 8″	87′ 7″	85′ 0″	52′ 9″	51′ 0″

The foregoing table shows that the average and the maximum length for both sexes is less in the Newfoundland specimens than for those captured on the Norwegian coast, a result similar to that obtained in the case of *B. physalus*. The measurements taken at the Newfoundland station other than my own cannot be considered accurate, though they are perhaps as accurate as those taken at the Norwegian stations. They both doubtless represent the largest possible measurements in the majority of cases, while mine are for the distance from the end of the upper jaw to the notch of the flukes. My measurements between June 19 and 28, 1901, average about thirteen inches less than those taken by the Newfoundland whalers from the same specimens. Even allowing for this circumstance, however, there is no doubt that larger whales are taken at the Newfoundland station earlier in the year than the time of my visit, and these are, or at least appear to be, smaller than those taken in former years at the Norwegian stations.

PROPORTIONS.

It will be observed that in Sars's diagnosis of *B. musculus*, quoted on p. 149, it is stated that the pectoral fin is "generally not more than $\frac{1}{7}$ the total length," and that the dorsal fin is extremely small and lies far back "at the beginning of the last fourth of the length of the body." During my sojourn at Balena station, Newfoundland, I made systematic measurements of specimens of Sulphurbottoms. Unfortunately, there is no body of measurements of European specimens with which these can be compared. Of only five or six adults have we any measurements beyond the total length, and these for the most part unsuitable for comparison. Such as they are, however, I have endeavored to use them in comparison with those in the following table:

[1] Specimens 72 feet and over.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND. 1901.

	No. 1. June 20.	No. 2. June 20.	No. 3. June 21.	No. 4. June 22.	No. 5. June 22.	No. 6. June 24.	No. 7. June 25.	No. 8. June 25.	No. 9. June 26.	No. 10. June 27.	No. 11. June 27.
Sex	♀	♂	♀	♀	♂	♂	♂	♀	♀	♂	♂
Total length, snout to notch	72′ 0″	71′ 0″	73′ 10″	73′ 6″	68′ 3″	65′ 0″	67′ 0″	61′ 0″	72′ 0″	72′ 7″	71′ 6″
Tip of snout to eye	15′ 1″	14′ 6″	16′ 0″	16′ 3″	14′ 6″	13′ 0″	14′ 6″	13′ 9″	15′ 5½″	15′ 3½″	14′ 8″
" " " " blowhole	.....	12 6	14 0	.....	.....	.....	12 8[3]	12 3[3]	13 6	.....	12 3[3]
" " " " post. base of pectoral	24 7	23 7	25 3	25 6	24 2	.....	2 45[4]	22 8	25 6	25 5	24 8
" " " " " " " " dorsal	.....	55 2	56 9	56 10	54 3	49 8	51 7½	47 3	56 10	.....	56 1
Length of pectoral from post. base	7 1	7 10	8 2	7 7	7 4	7 5	7 2[4]	6 9	7 9	7 10	7 10
" " " " head of humerus	9 10	10 7	11 5	11 0	10 4	10 8	10 8[4]	9 10	11 4	11 7	10 11
Greatest breadth of pectoral	2 5	2 6	2 10[1]	2 8[2]	2 8	2 8	2 10	2 6	2 8	3 0	2 8
Height of dorsal	0 8	0 9	0 8½	0 7½	0 9	0 10	0 7	0 9½	1 2	0 10	1 2
Notch to anus	18 5	20 7	20 8	19 7	18 2	20 0[2]	18 10	16 6	19 9	20 8	20 0
" " penis (or clitoris)	20 4½	20 7?	22 9	21 9	22 3	24 10[2]	23 10	18 0	21 7	25 5	26 1
Eye to ear	.....	3 10	4 2	3 8	3 8	3 8	3 8	3 5	3 9	3 10½	4 1
Diameter of eyeball, antero-post	.....	0 5	.....	.....	.....	.....	0 5	.....	.....	.....	.....
" " " vertical	.....	0 4½	.....	.....	.....	.....	.....	.....	.....	.....	.....
" " iris, antero-post.	.....	0 1⅜	0 1½	.....	.....	.....	.....	.....	.....	.....	.....
" " " vertical	.....	0 1¼	.....	.....	.....	.....	.....	.....	.....	.....	.....
Length of longest whalebone	2 8	.....	.....	.....	2 8	.....	.....	.....	1 11	2 3	2 0
Lower jaw beyond upper	1 9	.....	.....	1 4	.....	.....	1 3	.....	1 10	.....	.....

	No. 12. June 28.	No. 13. June 28.	No. 14. June 29.	No. 15. June 29.	No. 17. July 2.	No. 18. July 3.	No. 19. July 4.	No. 20. July 4.	No. 21. July 5.	No. 22. July 6.	No. 24. July 8.
Sex	♀	♀	♀	♂	♂	♂	♀	♀	♀	♀	♀
Total length, snout to notch	66′ 6″	65′ 11″	77′ 2″	63′ 6″	65′ 8″	72′ 2″	74′ 6″	70′ 3″	65′ 2″	61′ 3″	61′ 2″
Tip of snout to eye	14 4	14 1″	16 10	13 8	14 1	16 0	16 2	14 3″	13 4″	13 0″	12 5
" " " " blowhole	.....	11 3[5]	.....	12 3[5]	12 0	13 8[5]	.....	.....	11 3	.....	.....
" " " " post. base pectoral	23 7	23 2	.....	22 6	23 4	25 3	.....	23 9	22 5	22 2	.....
" " " " " " dorsal	.....	51 3	.....	49 3	51 3	55 11	.....	.....	49 2	.....	.....
Length of pectoral from post. base	7 0	6 10	{7 8[6] / 8 8[7]}	7 0	6 6	7 5	.....	6 4	6′10	6 9	6 8
" " " " h'd of hum's	10 2	9 10	{11 2[6] / 12 4[7]}	10 0	9 10	11 0	.....	9 9½	10 1	9 9	9 9
Greatest breadth of pectoral	2 9	2 9	3 2	2 6	2 8	2 9	.....	2 6	2 6	2 5	2 6
Height of dorsal	1 3½	0 6	0 10	0 7	0 8	0 8½	0 9½	0 9	0 7	0 10	0 8½
Notch to anus	19 10	18 9	22 0	17 9	17 8	19 6[9]	.....	19 1	19 6	18 2	18 5
" " penis (or clitoris)	21 5	23 7	24 0	22 4	22 5[8]	24 5[10]	.....	20 11	21 4	19 6	20 0
Breadth of flukes, tip to tip	.....	.....	.....	.....	16 0	16 10	.....	.....	.....	13 8?	15 8
Breadth of caudal peduncle	.....	.....	.....	.....	.....	.....	.....	5 8	5 11½	.....	.....
Eye to ear	3 5	3 8	.....	3 7	3 9	3 8½	4 2	3 7	3 4½	3 5	.....
Length, longest whalebone	1 8	.....	2 4	.....	.....	.....	2 0	2 0	.....	1 7	1 6

The foregoing measurements reduced to percentages of the total length are given in the following table, the sexes being separated and the different individuals arranged in order of size:

[1] Curved; 2′ 8″ straight. [2] Curved; 24′ 1″ straight. [3] Center. [4] Exact. [5] Center. [6] Left. [7] Right. [8] Post. end of orifice of sheath. [9] Along curve of peduncle, 20′1″. [10] Along curve, 25′.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND. 1901.

	No. 14	No. 19	No. 3	No. 4	No. 1	No. 9	No. 20	No. 12	No. 21	No. 22	No. 24	No. 8
Sex	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀
Total length	77′2″ 926″	74′6″ 894″	73′10″ 886″	73′6″ 882″	72′0″ 864″	72′0″ 864″	70′3″ 843″	66′6″ 798″	65′2″ 782″	61′3″ 735″	61′2″ 734″	61′0″ 732″
	%	%	%	%	%	%	%	%	%	%	%	%
Tip of snout to eye	21.8	21.7	21.6	22.1	20.9	21.5	20.3	21.6	20.5	21.2	20.3	22.5
" " " " blowhole	....	....	18.9	....	....	18.8	....	....	17.3	....	....	20.0[2]
" " " " post. base of pectoral	....	....	34.3	34.7	34.1	35.4	33.8	35.5	34.4	36.2	....	37.1
" " " " " " " " dorsal	....	....	76.9	77.3	....	78.9	27.0	....	75.5	....	....	77.5
Notch of flukes to anus	28.2	....	28.0	26.7	25.6	27.4	....	29.8	29.9	29.5	....	27.0
" " " " clitoris	31.1	....	30.8	29.6	28.3	29.8	29.8	32.2	32.7	31.8	....	29.5
Length of pectoral from post. base	10.6[1]	....	11.1	10.3	....	10.8	9.0	10.5	10.0	11.0	10.9	11.1
" " " " head of humerus	15.2[1]	....	15.4	14.9	....	15.8	13.9	15.3	15.5	15.9	15.8	16.1
Greatest breadth of pectoral	4.1	....	3.8	3.8	....	3.7	3.6	4.1	3.8	3.9	4.1	4.1
Height of dorsal (vertical)	1.1	1.1	0.96	0.86	....	1.4	1.1	1.9	0.9	1.4	1.2	1.3
Breadth of flukes	....	....	....	....	....	....	....	....	....	....	....	....

	No. 10	No. 18	No. 11	No. 2	No. 5	No. 7	No. 13	No. 17	No. 6	No. 15
Sex	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂
Total length	72′7″ 871″	72′2″ 866″	71′6″ 858″	71′0″ 852″	68′3″ 819″	67′0″ 804″	65′11″ 791″	65′8″ 788″	65′0″ 780″	63′6″ 762″
	%	%	%	%	%	%	%	%	%	%
Tip of snout to eye	21.1	22.2	20.5	20.4	21.3	21.6	21.4	21.4	20.0	21.5
" " " " blowhole	....	18.9[3]	17.1[3]	17.6	....	18.9[3]	17.1[3]	18.3	....	19.0
" " " " post. base of pectoral	35.2	35.0	34.5	33.2	35.4	36.4	35.2	35.5	....	35.4
" " " " " " " " dorsal	....	77.4	78.4	77.7	79.5	77.1	77.7	78.0	76.4	77.6
Notch of flukes to anus	28.5	27.0	28.0	28.5	26.6	28.1	28.4	26.9	30.8	27.9
" " " " penis	35.2	33.8	36.5	....	33.9	35.6	35.8	34.1	37.0	35.1
Length of pectoral from post. base	10.8	10.3	11.0	11.0	10.7	10.7	10.3	9.9	11.4	11.0
" " " " head of humerus	15.9	15.3	15.3	14.9	15.1	15.9	14.9	14.9	15.1	15.7
Greatest breadth of pectoral	4.1	3.8	3.7	3.5	3.9	4.2	4.2	4.0	4.1	3.9
Height of dorsal (vertical)	1.1	0.98	1.5	1.0	1.1	0.87	0.76	1.0	1.3	0.9
Breadth of flukes	....	23.3	....	....	....	....	....	24.4	....	....

As already stated, there is no considerable number of measurements of European specimens with which the Newfoundland figures can be compared, and these show such discrepancies as to be of little use. Some well-known specimens, such as the Ostend whale of 1827, cannot be considered at all on account of the uncertainty as to their real length, etc. Great pains have been taken in the following table to harmonize the measurements of the different specimens with each other and with the Newfoundland series, but the results are entirely unsatisfactory. Measurements in brackets are calculated from others given by the various observers. Eschricht's Greenland specimen is included here for convenience.

[1] Average of the two sides.

[3] Center.

BALÆNOPTERA MUSCULUS (L.). EUROPEAN.

	Yeretiki, Russia. 1885. (Cocks, 1886.)	N. Berwick, Scotland. 1831. (Knox, 1835.)	Longniddry, Scotland. Nov. 3, 1869. (Turner, 1872.)	Godhavn, Greenland. Aug. 12, 1843. (Eschricht, 1846.)	Oleron Id., France. March 10, 1827. (Fischer, 1881.)	Rügen Id., Germany. July, 1862. (Mänter, 1877.)	Gothenburg, Sweden. Oct. 29, 1865. (Malm, from Sars).[8]
Sex			♀	♀	♀	♂	♂
Total length	79′ 0″ 948″	78′ 0″ [2] 936″	[77′ 3″] 927″	68′ 0″ [5] 816″ [6]	17.54m (57′ 6″) 690″ [6]	52′ 5″ 629″	51′ 7″ 619″
	%	%	%	%	%	%	%
Tip of snout to eye	.....	.....	[20.5] [2]	.....	.....	18.0	[14.7]
" " " " blowhole	[16.8] [1]	.....	[17.0] [1]	.....	[16.4] [1]	15.7 [1]	15.3 [1]
" " " " posterior base of pectoral	.....	.....	[43.9] [4]	36.9	.....	33.1	.....
" " " " " " " " dorsal	.....	.....	[76.8]	78.9	.....	72.7	[75.8]
Notch of flukes to anus	.....	26.9	27.1	.....	32.3 [7]	30.4	[32.5]
" " " " clitoris (or penis)	.....	.....	30.9	31.9	35.1 [7]	.....	.....
Length of pectoral from posterior base	.....	.....	.....	11.3	11.6	.....	.....
" " " " head of humerus	.....	13.8 [3]	.....	16.5	.....	15.2	14.3
Greatest breadth of pectoral	3.2	4.9	.....	5.0	3.0	3.2	3.2
Height of dorsal (vertical)	.....	.....	.....	0.5	.....	.....	1.1
Breadth of flukes	.....	25.6	.....	24.1	20.3	.....	.....

From the uncertainties and contradictions of this table it is refreshing to turn to the excellent figure of an European Blue whale published in 1874 by Sars (*78*), whose work is notable for its accuracy. Sars states that this figure, which is from an 80-foot (Norwegian) female taken at Foyn's Finmark station, was made by him "with the greatest care" after repeated measurements and observations, and with the aid of photographs (*78*, 232; 8 sep.).

Measurements made on this figure, compared with those of the largest of the Newfoundland females of which I made full measurements, show an extremely close correspondence, as indicated below:

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND AND NORWAY.

Measurement.	Newfoundland, 1901. No. 3.	Sars's figure. 1874. ♀
Total length	73′ 10″	80′ 0″ (Norweg.)
	per cent.	per cent.
Tip of snout to eye	21.6	21.6
" " " " blowhole	18.9	18.5
" " " " posterior base of pectoral, or axilla	34.3	37.1
" " " " " " " " dorsal	76.9	77.0
Length of pectoral from posterior base, or axilla	11.1	11.0
Greatest breadth of pectoral	3.8	3.8
Height of dorsal	0.96	0.96

[1] Center.
[2] Straight.
[3] Skeleton.
[4] Must be incorrect.
[5] Danish measure, in straight line from lower jaw.
[6] " Longueur totale."
[7] From posterior margin of flukes.
[8] *B. carolinæ*.

The only real discrepancy, it will be observed, is in the distance from the tip of the snout to the posterior base of the pectoral fin. A glance at the figure will show that the latter point is difficult to determine upon.

In 1878 Sars published another figure, based on a male having a length of 67 ft., Norwegian (= 69 ft., English) — (*79*, 3 and 4, pl. 3). This is substantially the same as the figure of 1874, but differs a little in proportions. Compared with the ten Newfoundland males, which are of about the same size, the average percentages are as follows:

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND AND NORWAY.

Measurement.	Average of Ten Males. Newfoundland.	Sars's Figure, 1878. ♂
Total length		69′ 0″
	per cent.	per cent.
Tip of snout to eye	21.1	20.4
" " " " blowhole (center)	17.9	18.4
" " " posterior base of pectoral	35.1	35.0
" " " " " " dorsal	77.8	75.4
Length of pectoral from posterior base	10.7	11.2
Greatest breadth of pectoral	3.8	4.9
Height of dorsal	1.05	1.3

It will be seen that the principal differences between Sars's figure and the Newfoundland specimens are in the more forward position and greater height of the dorsal fin and the greater breadth of the pectoral. It is exactly in these particulars that the figure of 1878 differs from that published in 1874. On the other hand, in so far as these two figures agree with each other they are harmonious with the average of the Newfoundland specimens.

BALÆNOPTERA MUSCULUS (L.). (STEYPIREYDR.) ICELAND.

	A. Tegarhorn, Berufjord, East Coast.	B. Vedlfjord, in Nordfjord, East Coast.	C. Ditto.	D. Ditto.	E. Ditto.	F. Seydisfjord, East Coast.
Sex	♂	♂	♂	♂	♂	♀
Total length	843″ [1]	864″ [1]	960″ [1]	866″ [1]	889″ [1]	912″ [1]
	%	%	%	%	%	%
Tip of snout to eye	21.4	22.2	18.1	....	....	....
" " " " blowhole	19.4	18.8	15.5	....	....	....
" " " " pectoral	31.6	....	....	....	....	....
" " " " posterior margin of dorsal	76.5	....	....	78.5	....	....
Notch of flukes to anus	....	....	....	25.4	....	....
" " " " penis	....	....	....	33.3	36.1	....
Length of pectoral (from axilla?)	12.1	13.9	12.2	13.8	13.0	13.6
" " " from head of humerus	14.2	15.3	13.8	15.4	14.6	15.1
Greatest breadth of pectoral	2.7	....	3.1	3.5	3.2	3.4
Height of dorsal	0.83	....	0.73	....	....	0.77
Breadth of flukes	20.4	....	19.6	19.6	....	....

[1] Danish.

Sophus Hallas's excellent table of measurements of six Sulphurbottoms taken at Iceland in 1867 (*60*) affords means of comparing the Newfoundland and Norwegian specimens with Icelandic ones. His measurements reduced to percentages are given in the preceding table.

The averages for these six Iceland specimens and for the ten Newfoundland males, are as follows:

BALÆNOPTERA MUSCULUS (L.). ICELAND AND NEWFOUNDLAND.

Measurement.	Iceland Specimens.		Ten Newfoundland Specimens. Males.	
	per cent.		per cent.	
Tip of snout to eye	(3)	20.6		21.1
" " " " blowhole	(3)	17.9		17.9
" " " " pectoral	(1)	31.6[1]	(9)	35.1[2]
" " " " post. margin of dorsal	(2)	77.5	(9)	77.8
Notch of flukes to anus	(1)	25.4		28.1
" " " " penis	(2)	34.7	(9)	35.2
Length of pectoral	(6)	13.2[3]		10.7[2]
" " " from head of humerus	(6)	14.7		15.3
Greatest breadth of pectoral	(5)	3.2		3.8
Height of dorsal	(3)	0.78		1.05
Breadth of flukes	(3)	19.9	(2)	23.9

The agreement of the Iceland and Newfoundland specimens in many proportions is very close. The principal discrepancies are in the distance from the notch of the flukes to the anus, in the height of the dorsal fin, and in the breadth of the flukes. The first measurement was made on only one Iceland specimen. As to the second—the height of the dorsal,—it can only be said that the individual measurements and the average are within the limits of variation of the Newfoundland specimens in this particular. Still it would rather be expected that one of the three Iceland specimens measured by Hallas would have had a higher dorsal, if there is no constant difference between Iceland and Newfoundland Sulphurbottoms. Of the discrepancy in the breadth of the flukes little can be said, as the measurements are so few, and in the Newfoundland specimens so uncertain.

COLOR.

The best description of the color of European *B. musculus* with which I am acquainted is that given by Sars in 1874 (*78*, 233; 9, sep.), after he had seen ten specimens of the species at Foyn's whaling station in Finmark. It is as follows:

"In all the examples observed by me the whole body, as well on the back as on the belly, was of a uniform blue-gray or slate-gray color, somewhat darker on the head and breast, and lightest along the sides, where there is found a quite fine and peculiar mottling of darker and lighter shades. The whole ground color of the whale, seen at a distance, has very distinctly a bluish cast, and that in a more

[1] To anterior base? [2] To posterior base, or axilla. [3] Points of measurement not stated.

conspicuous manner than in any other whale with which I am acquainted. The name 'Blue whale,' bestowed on this species by Foyn, seems to me very suitable, and I will therefore propose that it be adopted for the species as the Norwegian common name. The pectoral fins externally are of the color of the body, but on the inner surface and the whole lower convex border, shining white, which color at a long distance contrasts sharply with the dark tints of the rest of the body. Quite constantly there occur also below the pectorals on the fluted sides of the breast a number of small milk-white spots, whose number and distribution vary considerably in different individuals. In addition, I have found in all individuals, more or less strongly marked, a lighter mottling above the roots of the pectorals and between them and the region of the eye. The flukes, as well above as below, are of the color of the body, but on the lower surface a little lighter than on the upper."

The color of the 25 or 30 Newfoundland specimens which I observed agreed well with this description, though I found, as in the case of the Common Finback, that there was a large individual variation, no two specimens being precisely alike.

Neither Sars's figure nor his description gives an adequate idea of the complicated coloration of the species. It would be futile to attempt a detailed description of the markings, but some idea may be given of the general disposition of the lighter and darker tints. In the Sulphurbottoms of Newfoundland the head, chin, throat, and lips are dark bluish-gray, darker than the rest of the body and uniform. All the remainder of the body is variously spotted, mottled, and lined with light gray, dark gray, and white. The shoulders, back, and sides are mottled with large irregularly elliptical marks of dark gray and light gray, the latter generally predominating, and sometimes almost excluding the dark color, so that the whole animal behind the eyes appears light gray. Even in these cases, however, there are areas of more or less dark color above the pectoral fins (when laid back) and the anus, and between the latter and the flukes.

The long axes of the elliptical light-gray markings take different directions. They sweep up around the base of the pectoral fin and are then directed obliquely downward and backward above the posterior ends of the furrows. They then point directly backward, or those of the upper rows upward and backward toward the top of the caudal peduncle.

The belly is invariably marked with distinct white spots, which, however, vary greatly in number. In some cases they are so numerous under the root of the pectoral fin as to produce a large white area, extending as a band backward toward the navel, and some spots are to be found down to the median line and scattered forward considerably in front of the pectoral fin, a few even invading the lips. In other cases the white spots run off the pectoral flutings posteriorly on to the flanks, between the navel and the anus. In other cases again, there are no white spots anterior to the base of the pectoral fin, and they only extend down to the median line at the posterior end of the pectoral flutings and there stop.

The under surface of the flukes near the root, from the anterior margin backward, is finely marked with alternating light and dark gray lines running anteroposteriorly, but finally curving inward toward the median line.

The central part of the surface of the dorsal fin is usually more or less white or whitish, streaked with vertical curved gray lines, but in some cases the light color is reduced to spots, or is altogether absent.

The pectorals are gray above and more or less distinctly mottled like the back. The under surface, anterior margin, and tip above and below are white.

The median line of the body below is usually plain dark gray between the anus and the flukes, but commonly more or less mottled with light color from the anus to the navel by the joining of the light areas of the two sides of the body. There are usually white marks and dashes around the anus, sexual orifice, and navel.

The variation in amount of white and gray on the pectorals of the Newfoundland Sulphurbottoms was very considerable and merits special mention.

The external, or upper, surface of the pectorals is gray proximally, and more or less white distally. The gray may be like the darker color of the back and uniform, or may be varied with from one to six or seven blotches of lighter gray. The white of the tip varies in extent from a mere continuation of the anterior white border, to a solid white area having a longitudinal extent of from 6 inches to 2 feet. In some cases the white extends backward, forming a narrow posterior border almost to the root of the pectoral. In other cases the backward extension takes the form of a succession of oblique white lines, rather than a continuous border of that color. In very light individuals white lines may run backward from the tip for nearly $\frac{1}{4}$ the length of the pectoral. The white area of the tip is always more or less varied by dark lines, which may be long or short, parallel or reticulated. The anterior margin of the pectorals is normally white throughout, but in some instances the dark gray of the external face extends across the proximal half, or there may be various gray lines. In one instance there was a dark-gray patch on the anterior margin near the middle of its length. The limb appeared to have been injured at this point.

The internal, or under, surface of the pectorals is normally white throughout, but there are almost always some gray lines and marks. These sometimes take the form of spots, but are usually lines, and may be fine or coarse, and either parallel with the axis of the pectoral, or oblique and reticulated. The single lines are sometimes quite long, reaching almost from the tip to the root of the pectoral. The shorter dark lines are most abundant about the tip, and those individuals in which the tips are malformed usually have the most markings.

The only important feature as regards coloration in which the Newfoundland Sulphurbottom appears to differ from the European, as shown by the preceding description, is in the color of the dorsal fin. In the Newfoundland specimens this fin was usually more or less white or whitish, except on the margins, with darker curved lines extending up vertically from its base. There is no mention of this peculiarity in the descriptions of European Sulphurbottoms I have consulted, though it must be said that in most of the accounts the dorsal fin is scarcely described at all. Sir Wm. Turner remarks of the Longniddry whale (*91*, 202) that the dorsal fin was "steel-gray or black, except near its posterior border, where it was a shade lighter and streaked with black lines." The introduction of black here

and elsewhere in the description makes it probable that the Longniddry whale was not in a fresh condition when observed by Turner, but otherwise the sentence quoted would appear to indicate that the dorsal was colored somewhat similarly to that of the Newfoundland specimens.

INDIVIDUAL VARIATION IN COLOR.

The following notes on the coloration of individual specimens were made by me immediately upon their being drawn out of the water. In most cases the whale had been brought in by the steamer a few hours previously, but occasionally one was brought in late at night and was not drawn out on the slip and examined until the following morning:

No. 1. Female. June 20, 1901. Total length, 72 feet. This whale was partly flensed when I examined it. Gray all over, and everywhere spotted except on the head, chin, throat, and breast. The spots on the sides and back are light gray, elliptical, with irregular margins; those on the belly smaller and nearly pure white. The dorsal fin has a light-gray, almost white, ground, with sinuous gray streaks running vertically, heaviest and darkest toward the tip, which is solid dark gray. Roof of mouth black; tongue slate gray. Left pectoral white underneath and on the anterior edge, with a few oblique streaks and rows of blackish spots. Externally the pectoral is white at the tip for about one foot, with narrow gray streaks running from the general gray color at the proximal end. Under surface of flukes, proximally, uniform gray.

No. 2. Male. June 20, 1901. Length, 71 feet. Head dark slate-color from opposite the base of the pectoral fin forward. The whole back gray, with large, irregular, elliptical light spots as far backward as a line midway between the dorsal fins and flukes, beyond which the spots are less numerous. Whitish along the base of the dorsal fin. On the abdominal ridges the amount of light and dark gray is about equally divided. The spots are smaller and whiter on the belly than on the flanks and back. The elliptical spots do not begin on the throat until about half-way from the snout to the pectoral fin. The majority are opposite the pectorals. From the posterior end of the abdominal ridges the spots of the sides come down and meet in the median line between the navel and the orifice of the penis. From the ear to the insertion of the pectoral fin, and again from the tip of that fin for a distance backward about equal to its length, the spots coalesce to form two large areas almost entirely light gray. The anterior portion of the under surface of the flukes proximally is streaked with light color. Anterior margin and whole underside of pectorals white; tip white externally for about two feet, and the whitish color extends backward along the lower external border nearly to the root of the fin. On the exterior of the left pectoral the white patches extend well beyond the base, and the white of the tip extends far toward the base, so that only the central area is uniform gray. An indefinite light line extends forward from the pectoral to the posterior angle of the eye and to the corner of the mouth. (See pl. 13, fig. 1.)

No. 3. Female. June 21, 1901. Total length, 73 ft. 10 in. Superior surface of the head to the eye, and as far back as the head of the humerus, uniform gray. The white spots of the belly are few and are confined to an area running obliquely from the base of the pectorals to the navel. Those of the two sides do not meet in the median line until nearly at the navel. From the navel to the clitoris the inferior median line is dark gray and without spots. On the sides of the body the light spots are exceedingly numerous and occupy a larger area than does the darker color. Their long axes have definite directions. They sweep around the base of the pectoral fin and are then directed obliquely downward and backward above the posterior ends of the abdominal ridges. They then point directly backward, or those of the upper rows upward and backward toward the top of the caudal peduncle. The sides of the caudal peduncle have more of the light color than the dark, and the same is true on the shoulder. The pectoral fins are white externally for about 6 inches from the tip, but the light gray spots do not extend forward from the base as much as in No. 2. The base of the flukes underneath is light gray anteriorly, with darkish fine lines running fore and aft, growing darker toward the posterior margin of the flukes, which is quite dark gray. (See pl. 13, fig. 2.)

No. 4. Female. June 22, 1901. Total length, 73 ft. 6 in. The sides of the body have more light color than dark, except above the pectoral fins (when laid back). The light color extends forward to a line drawn between the eye and the inferior median line opposite the head of the humerus. The inferior median line from the anus backward is plain gray. The spots of the two sides come together in the median line between the navel and clitoris; behind the anus they extend downward but do not meet in the median line. White spots on the breast very few, not reaching the median line. White dashes about the sides of the anus and pudendum. From the dorsal to the flukes, the sides of the caudal peduncle are nearly all light colored up to within about a foot of the superior edge, where the color is nearly all dark. Base of flukes below finely lined with darkish gray streaks running fore and aft, but curving inward toward the median line.

No. 5. Male. June 22, 1901. Total length, 68 ft. 3 in. A very light individual, light gray all over, the head alone being darker. The white blotches on the abdominal ridges are numerous and very white, and run off the posterior ends of the ridges along the flanks in the form of narrow elongated markings, quite unlike the elliptical gray blotches of some of the preceding specimens. Much white around the navel and some behind the anus. From a point about opposite the orifice of the penis, the white markings of the sides almost disappear, but they reappear in moderate abundance behind the line of the anus for a foot or two. This No. 5 has three large irregular white scars on the right side. The right pectoral has much of the posterior margin torn and irregular, and the tip broken. (See pl. 18, fig. 1.)

No. 6. Male. June 24, 1901. Total length, 65 feet. The light blotches of the sides meet in the median line between the navel and orifice of the penis. They are especially numerous at the posterior end of the ridges and are whitest there.

They cover the sides thickly as far back as the line of the anus, but grow gradually less and less numerous posteriorly. The white spots of the abdominal ridges extend downward from the base of the pectorals about 18 inches, and run thence to the posterior end of the ridges, and join the larger but less whitish markings of the sides. All the median posterior area of the ridges is practically without spots, and there are very few anterior to the base of the pectorals. There are quite numerous white marks at the sides of and behind the orifice of the penis, and below the anus. A triangular area of whitish spots and lines extends from the eye to the ear, with the apex at the eye. The whole shoulder, to the line of the tip of the pectoral (when laid back), is light and nearly uniform in color, breaking into large oblong spots, showing the darker ground-color between them as they approach the median line of the back. A long light area begins at the median line about opposite the tip of the pectoral and extends obliquely backward over the sides of the body, breaking into spots which extend in small numbers to the base of the flukes. Flukes streaked underneath (and indistinctly above) as in previous specimens, and there are some broad and long marks like scratches. A little white at the tip of the pectorals externally. (See pl. 14, fig. 7.)

No. 7. Male. June 25, 1901. Total length, 67 feet. This is a dark individual, but has much white on the abdominal ridges from the base of the pectorals obliquely downward and backward to the navel. The white here is in the form of continuous areas, with small elongated gray spots and dashes overlying them. The whole belly is mottled with lighter and darker shades of gray. The white of the two sides meets in the median line considerably in front of the navel. Both pectorals irregular at the tip, with dark longitudinal markings; also a darkish mark along the middle of the underside from the tip half-way to the root. Dorsal fin very white, *i. e.*, with vertical gray and white lines alternating. (See pl. 19, fig. 1.)

No. 8. Female. June 25, 1901. Total length, 61 feet. A moderately dark individual. Practically no white on the abdominal ridges anterior to the line of the base of the pectorals. Proximal half of anterior margin of pectorals gray, and irregular dark scratches at the tips. (See pl. 19, fig. 2.)

No. 9. Female. June 26, 1901. Total length, 72 feet. A very white individual, the whitest one seen. All white at the base of the pectorals, and about an equal mixture of white and gray on the abdominal ridges from that point backward. The white of the two sets of ridges meets in the median line. Little white on the ridges anterior to the base of the pectorals. The sides of the body from somewhat behind the tips of the pectorals (when laid back) nearly all light gray, with spots and areas of darker gray between. Much of the latter color from the dorsal fin backward along the superior margin of the caudal peduncle, while light blotches more or less clouded and spotted with darker gray extend all over the sides of the peduncle to the insertion of the flukes. A very light gray area on the shoulder and above the ear, extending thence obliquely backward toward the median line. Above the pectorals the back is varied with the gray ground-color and larger light gray spots in about equal amounts. The light-gray markings of the sides have a tendency to become whorls. From a distance, this whale seen from the dorsal aspect

looks uniform gray on the head, coarsely mottled with lighter from the shoulder to the middle of the length, thence practically all light gray to the flukes. The median line below, from the navel to the clitoris, is plain gray. Sides of pudendum below the mammary slits and around the anus nearly pure white. Underside and anterior margin of pectoral very pure white. The fore-and-aft curved lines of alternately gray and white very distinct on the underside of the flukes. Dorsal fin with a nearly pure white anterior basal area, with curved vertical narrow gray lines. (See pl. 14, fig. 1; pl. 18, figs. 3 and 4.)

No. 10. Male. June 27, 1901. A light individual. The back nearly all light gray, with dark blotches opposite the tip of the pectoral, opposite the anus, and adjoining the base of the flukes. Though light, the color is not white on the flukes, nor on the lower surface of the body, except on the ridges, and a dash or two about the penis and anus. The amount of white on the ridges very considerable. Median line between navel and anus mostly dark gray. But little light gray on the underside of the flukes. Pectorals blotched on the outside like the flanks with light gray, and the tips with a mass of reticulated dark lines below.

No. 11. Male. June 27, 1901. Total length, 71 ft. 6 in. A moderately light individual. Flanks mottled dark and light as in other specimens. From the dorsal fin half-way to the flukes the sides are nearly all light gray in continuous masses. The remainder of the sides toward the flukes nearly all dark gray. Flukes quite white underneath, with the usual fore-and-aft gray curved lines. A dark patch on the anterior margin of the pectoral just proximal to the middle of its length (perhaps due to injury). Sundry dark marks at the tip below. White dashes around the anus, penis orifice, and navel. Median line, from the navel to the penis orifice and around right side of the latter, dark gray, without light blotches. More posteriorly, the light blotches of the flanks cross the median line. (See pl. 20, fig. 3.)

No. 12. Female. June 28, 1901. Total length, 66 ft. 6 in. About medium as regards color. Light spots run forward to the corner of the mouth. They do not extend to the eye, but stop about midway between it and the ear. On the top of the head, however, they extend forward to the line of the ear. The proximal half of the pectorals externally has several large light blotches, but they are not conspicuous. Tip of pectorals with very little white externally.

No. 13. Male. June 28, 1901. Total length, 65 ft. 11 in. Very few white spots on the abdominal ridges, which are almost entirely plain gray, except for an indistinct mottling. A broad inferior median band of plain dark gray from the navel to the anus, with only a few dashes of light gray. The light spots in this whale show a strong tendency to form whorls, especially on the flanks, where they nearly all assume this character. Pectorals externally all dark gray, with but one or two small light blotches about an inch in diameter at the posterior margin, where are also some vermiform lightish marks.

No. 14. Female. June 29, 1901. Total length, 77 ft. 2 in. A very light whale. A great deal of white on the abdominal ridges. The region under the base of the pectorals nearly solid white. The white spots on the ridges extend

as far forward as the middle of the right lower lip, and there are a few white dashes on the middle of the lip itself. Body very light around the head of the humerus. Flanks nearly solid light gray from the line of the pudendum to the flukes. Flukes very light underneath, especially nearest the anterior margin. Dorsal fin almost white except at the tip and about the posterior free margin. Tip of left pectoral white for about one foot or more externally, with lines and white markings running proximally nearly to the middle of the length, and considerable white along the posterior margin. No light blotches visible on the external face of the left pectoral, but there are some on the right pectoral.

The right side in this whale appears to be lighter than the left.

No. 15. Male. June 29, 1901. Total length, 63 ft. 6 in. A darkish individual, with very little white on the ridges, and there mostly close under the pectorals, especially at their base. The inferior median line broadly plain gray as far back as the anus, though with occasional lighter blotches and marks. Dorsal fin with only a few vertical curved light lines on the darker ground-color. (See pl. 20, fig. 4.)

No. 17. Male. July 2, 1901. Total length, 65 ft. 8 in. A moderately light individual. A considerable number of white spots at the posterior end of the abdominal ridges, but the clear white does not run on to the flanks. Posterior half of the ridges much and finely speckled with dark-gray marks on a lighter ground. The belly and breast become darker anteriorly, and the navel region is, therefore, the lightest part of the under surface of the body. Some white dashes about the anus, but the median line posterior to the navel otherwise mostly dark and finely mottled and lined. Back plain dark gray throughout. The lightest part of the sides is midway between the line of the dorsal fin and the flukes. No white spots anterior to the base of the pectorals. Dorsal fin with a white antero-basal area, crossed by vertical curved gray lines. Flukes normal in color, with fore-and-aft light lines, or rather a whitish ground-color, with gray lines crossing it.

No. 18. Male. July 3, 1901. Total length, 72 ft. 2 in. Not a very light individual. Flanks, from the line of the orifice of the penis backward, largely plain dark gray. A moderate number of white spots on the abdominal ridges posterior to the pectorals, and these spots run off on to the flanks inferiorly about as far as the orifice of the penis. Scattered white marks are found as far back as the anus. Navel white.

No. 19. Female. July 4, 1901. Total length, 74 ft. 6 in. Quite a light individual, the sides being nearly all light gray from the line of the anus nearly to the flukes. Shoulders the same. One or two light blotches on the right lip at the anterior ends of the furrows.

No. 20. Female. July 4, 1901. Total length, 70 ft. 3 in. The inferior half of the sides of the body practically all light gray, through the confluence of the light blotches. The middle of the sides (longitudinally) posterior to the line of the anus much blotched, and the blotches turn to streaks at the base of the flukes and run into the lines of the underside of the flukes. Inferior median line posterior to the navel blotched. A large amount of white on the abdominal ridges, especially

at their posterior ends. Under the base of the pectorals a semicircular area of nearly pure white about two feet in diameter. Light (but not white) spots scattered far forward and anterior to the line of the corner of the mouth. Navel white. Proximal half of the anterior margin of the right pectoral invaded by the dark color of the external face. Tip dark, with various dark lines extending backward on the internal face. Left pectoral all light gray at the base externally, and light blotches and marks extend nearly to the tip. (See pl. 17, figs. 2 and 4.)

No. 21. Female. July 5, 1901. Total length, 65 ft. 2 in. A very light individual. The ground color light gray and the markings nearly white. On the abdominal ridges a broad band of white extends from the base of the pectorals (where there is a large white area) obliquely downward and backward to the posterior end of the ridges, being produced by the coalescence of the white spots. Anteriorly, white spots extend on the ridges far beyond the line of the eye. Light streaks above and below the eye, and some light blotches on the left jaw. An almost white line runs into the eye from behind and streaks of nearly pure white cover a triangular area between the eye and the ear. Inferior median line, from the navel to the pudendum, plain gray. Numerous white dashes around the anus and pudendum. Flukes with a white ground underneath anteriorly, overlaid with gray fore-and-aft lines. The white of the underside of the left pectoral invades the external face at the tip, making the whole tip white externally; white lines run from the tip externally, nearly one-quarter the length of the fin. (See pl. 14, fig. 2; pl. 18, fig. 2; pl. 20, fig. 2; pl. 21, fig. 3.)

No. 25. Female. July 8, 1901. Total length, 69 ft. 6 in. A light individual. Inferior median line blotched throughout. Much white on the abdominal ridges. Dorsal fin not light, nor white.

No. 26. Female. July 8, 1901. Total length, 65 ft. 8 in. A dark individual. The flanks show much more dark gray than light, the blotches of the latter color being distinct from each other and scattered. White spots on the abdominal ridges clear, but scattered. At the head of the humerus the same, but above the pectoral fin the blotches on the sides of the body fuse together into a nearly solid light area. Light color extends forward to the eye and the corner of the mouth. Tip of the pectorals, externally, white for about a foot. (See pl. 17, figs. 1 and 3.)

Hallas gave in 1868 (*60*, 162) most excellent data regarding the color of six Iceland Sulphurbottoms, which make it possible to institute detailed comparisons with the Newfoundland specimens. His notes on color reduced to tabular form are as follows:

BALÆNOPTERA MUSCULUS (L.). ICELAND.

Color of head and back.

A.	Tegarhorn, Berufjord. ♂.	Dark gray, with single irregularly-distributed lighter dashes and spots.
B.	Vedfjord, in Nordfjord. ♂.	Uniform dark gray.
C.	Ditto. ♂.	Dark gray, with lighter dashes, or spots.
D.	Ditto. ♂.	Uniform dark gray.
E.	Ditto. ♂.	Dark gray, without gradations.
F.	East of Seydifsjord. ♀.	Dark gray, with lighter dashes and spots.

Color of sides of body.

A.	Tegarhorn, Berufjord. ♂.	Dark gray, with lighter dashes.
B.	Vedfjord, in Nordfjord. ♂.	Grayish black.
C.	Ditto. ♂.	Grayish black.
D.	Ditto. ♂.	Grayish black.
E.	Ditto. ♂.	Grayish black.
F.	East of Seydisfjord. ♀.	Grayish black, without gradations.

Color of inferior surfaces, between furrows and flukes.

A.	Tegarhorn, Berufjord. ♂.	Uniform gray.
B	Vedfjord, in Fordfjord. ♂.	Belly gray.
C.	Ditto. ♂.	Belly gray, with single dark gray dashes, irregularly placed.
D.	Ditto. ♂.	Belly grayish black, with single snow-white irregularly-placed spots.
E.	Ditto. ♂.	Belly gray, with a number of irregular, snow-white spots.
F.	East of Seydisfjord. ♀.	Belly gray, with single snow-white spots disposed irregularly.

Color of ridges from throat to belly.

A.	Tegarhorn, Berufjord. ♂.	Dark gray; on the whole belly a number of snow-white, irregularly-placed, mostly linear specks.
B.	Vedfjord, in Nordfjord. ♂.	Dark gray.
C.	Ditto. ♂.	Dark gray.
D.	Ditto. ♂.	Dark gray, with irregularly-strewn white spots.
E.	Ditto. ♂.	Grayish black.
F.	East of Seydisfjord. ♀.	Dark gray, with snow-white spots strewn singly,—also in the furrows.

Color of furrows.

A.	Tegarhorn, Berufjord. ♂.	Light gray.
B.	Vedfjord, in Nordfjord. ♂.	Light gray.
C.	Ditto. ♂.	(Not given.)
D.	Ditto. ♂.	(Not given.)
E.	Ditto. ♂.	(Not given.)
F.	East of Seydisfjord. ♀.	(Not given.)

Color of pectoral fins above.

A.	Tegarhorn, Berufjord. ♂.	Dark gray, with numerous lighter specks.
B.	Vedfjord, in Nordfjord. ♂.	Uniform dark gray.
C.	Ditto. ♂.	Dark gray, with lighter dashes.
D.	Ditto. ♂.	(Not given.)
E.	Ditto. ♂.	Dark gray.
F.	East of Seydisfjord. ♀.	Uniform dark gray.

Color of pectoral fins below.

A.	Tegarhorn, Berufjord. ♂.	Entirely snow-white.
B.	Vedfjord, in Nordfjord. ♂.	White.
C.	Ditto. ♂.	Snow-white. A small portion against the body grayish-white.
D.	Ditto. ♂.	(Not given.)
E.	Ditto. ♂.	Snow-white.
F.	East of Seydisfjord. ♀.	Snow-white. A distinct scar-like stripe on the border.

Color of dorsal fin.

A.	Tegarhorn, Berufjord. ♂.	Dark gray, with lighter dashes.
B.	Vedfjord, in Nordfjord. ♂.	Uniform dark gray.
C.	Ditto. ♂.	Uniform dark gray.
D.	Ditto. ♂.	Dark gray.
E.	Ditto. ♂.	Dark gray.
F.	East of Seydisfjord. ♀.	(Not given.)

Color of flukes above.

A.	Tegarhorn, Berufjord. ♂.	Dark gray, with lighter dashes.
B.	Vedfjord, in Nordfjord. ♂.	Uniform dark gray.
C.	Ditto. ♂.	Dark gray, with lighter dashes.
D.	Ditto. ♂.	Dark gray.
E.	Ditto. ♂.	Dark gray.
F.	East of Seydisfjord. ♀.	Dark gray.

Color of flukes below.

A.	Tegarhorn, Berufjord. ♂.	Dark gray, with lighter dashes.
B.	Vedfjord, in Nordfjord. ♂.	Uniform dark gray.
C.	Ditto. ♂.	(Not given.)
D.	Ditto. ♂.	Dark gray.
E.	Ditto. ♂.	Dark gray.
F.	East of Seydisfjord. ♀.	Dark gray.

Color of whalebone.

A.	Tegarhorn, Berufjord. ♂.	All shining black.
B.	Vedfjord, in Nordfjord. ♂.	All glistening black.
C.	Ditto. ♂.	All shining black.
D.	Ditto. ♂.	All shining black.
E.	Ditto. ♂.	Shining black.
F.	East of Seydisfjord. ♀.	(Not given.)

On comparing the data in the foregoing table with the descriptions of the color of specimens of the Newfoundland Sulphurbottom, previously given, it will be seen that the coloration in both cases is the same, and that the range and character of variation in markings are likewise the same. Hallas's specimens were probably in some cases not so fresh as those I saw in Newfoundland; hence the frequent use of the term "grayish black" *(graasorte)*.

DORSAL FIN.

In Sars's account of the "Blaahval" the variations in the shape of the dorsal fin are described as follows: (*78*, 237; sep., 13):

"Not less characteristic of this species than the pectoral fins is the dorsal fin, which with its unusually small size and position far backward, or at the beginning of the last fourth of the total length and much back of the vertical line drawn through the anus, is at once distinguished from those of all other known whalebone whales. In its form it is at the same time the part which, as it appears, undergoes

not so unimportant variations. Its size also can differ in a high degree in different individuals. In some examples it was noticeably smaller in proportion than in Malm's specimen, so that it could be taken for an insignificant process or point projecting from the dorsal keel. In other individuals it was more developed, now more erect, now more strongly curved backward, though without ever approaching near the size it has in the other Finbacks."

The same range of variation of form was found in the dorsal fin of the Newfoundland Sulphurbottom, as will be seen by consulting text figs. 37–42. The following variations were observed:

No. 1. Female. Dorsal strongly recurved; tip regularly rounded; posterior margin deeply concave. (Text fig. 39.)

No. 2. Male. Dorsal erect, triangular; tip sharp; posterior margin straight. (Text fig. 42.)

No. 3. Female. Dorsal intermediate in curvature between those of Nos. 1 and 2; neither so recurved as in No. 1, nor so straight as in No. 2.

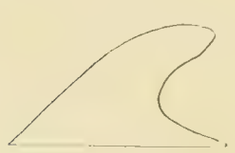


FIG. 37.

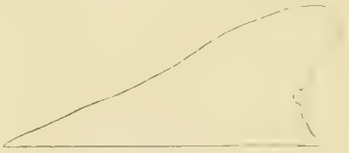


FIG. 38.

FIG. 39.

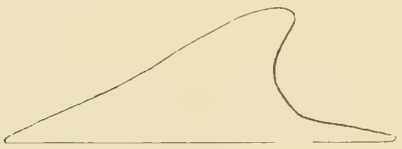


FIG. 40.

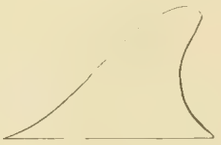


FIG. 41.

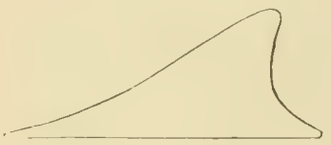


FIG. 42.

FIG. 43.

FIG. 44.

DORSAL FIN OF *BALÆNOPTERA MUSCULUS* (L.)

FIG. 37.—No. 14, ♀, Balena Station, Newfoundland. FIG. 38.—No. 22, ♀, *ditto*. FIG. 39.—No. 1, ♀, *ditto*. FIG. 40.—No. 7, ♂, *ditto*. FIG. 41.—No. 11, ♂, *ditto*. FIG. 42.—No. 2, ♂, *ditto*. FIGS. 43 AND 44.—Iceland. (From Hallas.)

No. 4. Female. Dorsal almost exactly as in No. 1.

No. 5. Male. Dorsal had been injured and also had a semicircular piece missing from the posterior margin, as if cut out by a bullet.

No. 7. Male. Dorsal moderately recurved; tip quite sharp; posterior margin deeply concave. (Text fig. 40.)

No. 11. Male. Dorsal large, erect, rather sharp at the apex; posterior margin moderately concave. (Text fig. 41.)

No. 14. Female. Dorsal high and narrow, strongly recurved, and deeply concave posteriorly. (Text fig. 37.)

No. 15. Male. Dorsal small, sharp-pointed, and strongly reclined.

No. 20. Female. Dorsal falcate.

No. 22. Female. Dorsal moderately recurved; tip regularly rounded; posterior margin moderately concave, with a small semicircular piece wanting near the middle. (Text fig. 38.)

No. 24. Female. Dorsal very strongly recurved, long, and low; the tip acuminate, and posterior margin very concave.

No. 25. Female. Dorsal erect, triangular, and sharp-pointed; posterior margin straight.

Sars's remark, that in size the dorsal fin of the "Blaahval" varies considerably but does not reach that found in other Finbacks, is probably not strictly correct as regards European *B. musculus* generally, and is not applicable to the Newfoundland Sulphurbottoms. In the latter, according to my own observations, the largest dorsal had an actual vertical height of 15½ inches, while 14 inches was the height of the smallest dorsal found in a Newfoundland *B. physalus*. The latter individual was, however, but 59 ft. 1 in. long, while the Sulphurbottom was 66 ft. 6 in. long, so that the fin though actually larger in the *B. musculus* was *proportionally* larger in the *B. physalus*.

The greatest proportional height of dorsal in the Newfoundland Sulphurbottoms was 1.9 % of the total length, while the least proportional height in Newfoundland *B. physalus* was 2.0 %. The extremes in the two species, therefore, tend to approach each other quite closely. On the other hand, it should be remembered that the *average* proportional height of the dorsal in 21 Newfoundland Sulphurbottoms was 1.1 %, while the average in 11 Newfoundland *B. physalus* was 2.4 %.

PECTORAL FINS.

Regarding the pectoral fins of European *B. musculus*, Sars remarks as follows (*78*, 236):

"The outer parts, or hands, are considerably more elongated than in the Common Finbacks and the whole pectoral fin more strongly curved, so that the lower convex margin is more distinctly arched, while the upper sharp border, which in the Common Finbacks has in the middle a more or less distinct angular projection, shows a more even curve. The breadth of the pectoral fins is about one quarter the length. For the rest, these organs appear to be subject to endless variations in different individuals, both in size and form, which, however, are confined within quite narrow limits. Very often I have found that they showed at the outer angle, near the tip, one or more deep angular emarginations, which always corresponded to the interval between the fingers, though I was not able to see any distinct trace of an external lesion."

These remarks apply equally well to the Newfoundland Sulphurbottoms, as will be seen by comparing the plates, and especially pls. 21 and 13, except that

the irregularity of the end of the pectorals which occurs in many individuals, appears to me to be due in most cases to external injury. The normal, complete termination is shown in pl. 21, fig. 3. When the pectorals are blunt, the softer parts are affected while the bones remain normal. This appears to indicate that the injuries are caused by contact with bodies harder than the skin and ligaments, but that the force of impact is not sufficient to fracture the bones of the digits. Such injuries might perhaps be caused by rubbing against rocks at the bottom of the bays which these animals frequent, but I suspect that they are sometimes caused by the bites of sharks and porpoises. The malformation of the pectorals is often accompanied by abnormalities elsewhere on the body.

Of the Newfoundland Sulphurbottoms, No. 8, ♀, had the tip of the pectorals blunted. In No. 4, ♀, the tip of the right pectoral was injured and apparently diseased, while the left was normal. In this individual, the inferior surface of the posterior end of the caudal peduncle also showed indications of injuries. In No. 5, ♂, the right pectoral had much of the posterior margin torn and irregular, and the tip distorted, as if broken. In this individual the dorsal was also injured and had a semicircular piece lacking from the posterior margin, as if pierced by a bullet. In No. 7, ♂, the tip of both pectorals was blunted and irregular. The whalebone was defective in this individual. In No. 8, ♀, both pectorals were blunted and irregular, as in the preceding specimen. The tip of the left pectoral in No. 14, ♀, was blunt. In No. 17, ♂, the tip of the left pectoral was remarkably blunted and serrated, with a prominent finger-like projection on the radial side. The right pectoral had a small hole in the posterior margin at a point distant from the axilla equal to one third the total length. No. 20, ♀, had the tip of the right pectoral irregular.

SHAPE OF THE HEAD.

The form of the head on the Newfoundland Sulphurbottoms is peculiar and characteristic. The blowholes are situated in a depression slightly below the general level of the top of the back. In front of them rises abruptly a strong median ridge, the top of which is somewhat above the level of the back. This ridge slopes down rapidly in front, but continues to the apex of the jaw. On each side of the blowholes is a thick rounded eminence, the top of which is about on a level with the top of the median ridge. This eminence is prolonged anteriorly as a sloping, attenuated, and rounded ridge which lies close to the median ridge, and dies away without reaching the tip of the jaw. External to this are the elevated, thick margins of the jaw, which are especially heavy near the apex of the jaw. Viewed from the side, the snout, or rostrum, presents a series of ridges and depressions, and from in front a most striking rotundity, on account of its great breadth and thick integuments. These features are shown in pl. 15 and pl. 13, figs. 3 and 4.

In No. 2, ♂, 71 feet in length, the distance from eye to eye, across the region of the blowholes, was 10 ft. 2 in.; across the rostrum half-way between the apex and the blowholes, 5 ft. 5 in. In No. 9, ♀, length 72 feet, the distance across the

head from eye to eye was 11 ft. 2 in. In No. 15, ♂, length 68 ft. 3 in., the length of the blowholes was 18½ inches.

EYE.

The eyeball in a male Newfoundland Sulphurbottom 71 feet long, as shown in the table on p. 157, was 5 inches in antero-posterior diameter and 4½ in. in vertical diameter. The iris was 1¾ inches antero-posteriorly and 1¼ inches vertically. The color of the iris is brown. The pupil is oblong with a straight superior margin.

The eye in the Newfoundland Sulphurbottom is situated behind and a little above the corner of the mouth, and with the lids forms a semi-elliptical swelling on the side of the head, below which is a quite deep depression, or furrow, directed obliquely downward in front toward the corner of the mouth. On the upper and lower lids are one or two shallow, curved furrows, and at the anterior commissure is a prominent ridge, bounded by a groove above and below, as in *B. physalus*. (Pl. 16, figs. 1 and 2.)

CIRCUMFERENCE AND DIAMETER OF BODY AND DEPTH OF THE CAUDAL PEDUNCLE.

The caudal peduncle, called "the small" by whalemen, is strongly compressed and ends abrupt at its union with the flukes, not gradually diminishing in breadth, as commonly represented in figures. In various specimens of Newfoundland Sulphurbottoms the vertical depth of the caudal peduncle was as follows:

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND. CAUDAL PEDUNCLE.

No.	Sex.	Total Length.	Depth of Caudal Peduncle.		
			Midway between Anus and Insertion of Flukes.	Midway between Anus and Notch of Flukes.	Midway between post. Base of Dorsal and Insertion of Flukes.
4	♀	73′ 6″	....	....	5′ 8″
18	♂	72′ 2″	....	5′ 11″	...
9	♀	72′ 0″	....	6′ 9″	....
11	♂	71′ 6″	....	....	3′ 6″ [1]
5	♂	68′ 3″	....	....	6′ 8″
13	♂	65′ 11″	....	6′ 0″	....
17	♂	65′ 8″	5′ 8″	....	....
15	♂	63′ 6″	....	6′ 0″	....
8	♀	61′ 0″	....	5′ 10″	....

The greatest diameter of the body and largest semi-circumference of several of the Newfoundland Sulphurbottoms were measured, with the following results:

[1] At insertion of flukes.

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND. GIRTH.

No.	Sex.	Length.	Semi-Circumference of Body.				Transverse Diameter of Body.	
			At Tip of Pectoral.	At Navel.	At Anus.	At Penis.	At Tip of Pectoral.	At Head of Humerus.
18	♂	72′ 2″	17′ 2″	....	9′ 6″	11′ 0″	....	....
9	♀	72′ 0″	18′ 2″	13′ 2″	....	....	7′ 6″	....
5	♂	68′ 3″	17′ 0″	....	....	....	....	....
7	♂	67′ 0″	....	....	....	....	6′ 3½″	7′ 6″

In Nos. 18, 9, 5, the girth at the tip of the pectorals, or the greatest girth, would be, by calculation, 34 ft. 4 in., 36 ft. 4 in., and 34 ft., respectively.

ABDOMINAL RIDGES AND FURROWS.

The abdominal or thoracic ridges and furrows in this species, as in *B. physalus*, extend backward from the mandible to the navel, and between the pectoral fins and eye extend upward nearly to the level of the latter. The ridges also anastomose irregularly, and toward the posterior end many pairs unite, so that the total number here is much less than it is farther forward, and the breadth of each much greater. The breadth of the larger ridges between the pectoral fins in the Newfoundland Sulphurbottoms is about 2½ inches. (Pl. 14, figs. 4–6.)

In number the ridges vary as in *B. physalus*, and the totals do not differ materially from those of that species. In different specimens of Newfoundland Sulphurbottoms the totals were as follows, and were obtained by counting from the median line to the root of the pectoral and multiplying by two:

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND. NUMBER OF ABDOMINAL RIDGES.

No.	Sex.	Total Length.	Number of Ridges.
14	♀	77′ 2″	66
4	♀	73′ 6″	68
18	♂	72′ 2″	62
9	♀	72′ 0″	88
11	♂	71′ 6″	68
2	♂	71′ 0″	84
20	♀	70′ 3″	68
7	♂	67′ 0″	68
17	♂	65′ 8″	62
6	♂	65′ 0″	58
8	♀	61′ 0″	84

The quite remarkable variation in number of ridges appears not to be correlated with sex or size.

NAVEL AND MAMMARY SLITS.

The navel in the Newfoundland Sulphurbottoms is a more or less elongated scar, usually about 8 in. long, surrounded by the abdominal ridges and furrows, which are somewhat displaced and bent outward by it and usually extend somewhat beyond it. (Pl. 17, figs. 1 and 2; pl. 18, figs. 3 and 4; pl. 19, fig. 2.)

The mammæ of the female are contained in longitudinal slits situated a little above the median line and opposite the end of the clitoris. Above and below these slits, or, in other words, nearer to and farther from the median line, are one or several furrows which are parallel with the slits. The largest of these furrows is commonly longer than the mammary slit and very deep. (See pl. 20, figs. 1 and 2.) In No. 8, 61 feet long, the mammary slits were 15 inches long.

The mammary slits and other parts surrounding the sexual orifice do not cause any marked convexity of the inferior outline of the body, but there is a slight depression posteriorly which marks the position of the anus. (See pl. 19, fig. 3.)

The male Sulphurbottom has rudimentary mammæ of considerable size concealed in slits like those of the female. (Pl. 20, figs. 3 and 4.) These slits are situated about midway between the anus and penis orifice, and are unaccompanied by parallel furrows. In No. 2 (length 71 feet), the left slit was 16 inches long and the right 19 inches. The orifice of the sheath of the penis in No. 15 (length 63 ft. 6 in.) was 3 feet long. The penis itself in No. 2 (length 71 feet) was 6 feet long on the curve; circumference of the glans at the base, 2 feet. Testicle in No. 13 (length 65 ft. 11 in.), 27 inches long, 10 inches broad.

FLUKES.

The flukes were invariably cut off the Newfoundland Sulphurbottoms before towing them in and I did not have an opportunity to see them in the adult. In a fœtus 12 feet long they had the form characteristic in the genus, convex anteriorly, slightly concave posteriorly, with moderately recurved tips, and a central notch. In No. 6, ♂, 65 feet long, the depth of the flukes from the notch to the line of the anterior base, or insertion, was 3 ft. 6 in.; in No. 11, ♂, length 71 ft. 6 in., the depth of the flukes at the same place was 3 ft. 8 in.; in No. 14, ♀, length 77 ft. 2 in., the depth of flukes was 4 ft. 9½ in. The depth of the notch in this individual was 9 inches. It was very obtuse.

WHALEBONE.

The whalebone in the Newfoundland Sulphurbottoms (pl. 15, figs. 1 and 2; pl. 16, figs. 3 and 4) is thick and black throughout, including the bristles, as in the European specimens. In eleven specimens from the former locality, its length above the gum (without the bristles) was as follows:

BALÆNOPTERA MUSCULUS (L.). NEWFOUNDLAND. LENGTH OF WHALEBONE.

No.	Sex.	Length of Whale.	Length of Longest Whalebone.
			Inches.
14	♀	77′ 2″	28
19	♀	74′ 6″	24
10	♂	72′ 7″	27
1	♀	72′ 0″	32
9	♀	72′ 0″	23
11	♂	71′ 6″	24
20	♀	70′ 3″	24
5	♂	68′ 3″	32
12	♀	66′ 6″	20
22	♀	61′ 3″	19
24	♀	61′ 2″	18
		Average.....	24.7 inches.

The length 32 inches must be regarded as exceptional. In a lot of whalebone stored in the yard at the station, the longest I could find was 27 inches, above the gum, and without the bristles. As this was from a very large number of whales, probably between 40 and 50, it seems singular that I should have encountered longer whalebone in three instances in the whales I personally examined. I cannot account for this except on the theory that the whalebone shrinks when exposed to the air for a considerable time.

In the Longniddry (Scotland) whale, the whalebone was reported by Turner as 33½ inches long, including the part imbedded in the gum, or about 29½ inches without it.

The length of the longest bristles in a Newfoundland Sulphurbottom (length 77 ft. 2 in.) was 18 inches.

HAIRS.

The scattered hairs found on the head and mandible of fœtal whales are not always discoverable on the adults. In the majority of the Newfoundland Sulphurbottoms they were not noticed, but on No. 9, ♀ (length 72 ft.), there was a row of dirty white or yellowish hairs along the proximal half of the left ramus of the mandible, and on the head a row starting with two from behind the blowholes, curving around them on a semicircle to their anterior end and running thence to the tip of the snout; a second row of hairs was situated nearer the margin of the jaw. In No. 23, ♀ (length 67 ft. 3 in.), a row of about 6 hairs, each in a raised tubercle, occurred at the proximal end of the right ramus of the mandible. In several specimens was to be noticed a vertical double row of yellowish hairs at the symphysis of the mandible, the hairs themselves being about 3 in. apart.

OSTEOLOGY.

The skeleton of *Balænoptera musculus* has been described by Flower (*45*, 410–414) under the name of *Physalus latirostris*, and by Reinhardt (*75*), Van

Beneden and Gervais (*8*), and others. Unfortunately, there is almost nothing in the way of American material which can be compared with the European specimens. The only skeleton in any of the museums of the United States is that of the specimen stranded at Ocean City, New Jersey, in October, 1891, which is in the collection of the Philadelphia Academy of Natural Sciences. This whale was examined and measured by Mr. J. C. Ives and myself, and was afterward the subject of an article by Cope (*31*).[1]

The length of this specimen as it lay on the beach was 66 ft. 2 in. The unmounted skeleton at the Philadelphia Academy measures 52 ft. 2 in. as it lies, but lacks the premaxillæ and one intermediate and probably three terminal caudal vertebræ, and the bones are much too close together.

Cope came to the conclusion that it combined the characters of *B. physalus* and *B. musculus*, and remarked in closing his article: "It remains to be ascertained whether these characters indicate another species, and if so, whether the names *duguidii* or *tectirostris* are applicable to it." The species called *B. tectirostris* by Cope is, as we have seen in a previous chapter, the Common Finback of the Atlantic coast of North America, and identical with *B. physalus*. The nominal species known as *B. duguidii* is also identical with *B. physalus*. The real question, therefore, is whether the Ocean City whale is the Sulphurbottom of Newfoundland, or whether it represents *B. physalus*, or belongs to an unknown species.

Cope's summary is in three divisions, as follows:

(1) "The Ocean City whale agrees with *Balænoptera musculus* [= *B. physalus* (L.)] in the form of the head, number of vertebræ and ribs, proportions of pectoral fin, and position of dorsal fin."

(2) "It differs from this species [*B. physalus* (L.)] and agrees with *B. sibbaldii* [= *B. musculus* (L.)] in the size, color, and in structure of the cervical vertebræ."

(3) "It is intermediate between the two, as described by authors, in the numbers of the phalanges of the manus."

I shall endeavor to show that the points mentioned in the first division are erroneous. The skeleton, when I saw it in 1900, was unmounted and lying on the floor of one of the exhibition halls in the Philadelphia Academy. It was nearly complete, but lacked several caudal vertebræ, the nasal bones, etc. The maxillæ were separated from the cranium.

The first point made by Cope is that the form of the head agrees with *B. physalus* rather than with *B. musculus*. In the course of his description he remarks (*31*) that the maxillæ "have the acuminate outline of those of *B. musculus* [= *B. physalus* (L.)] rather than that of *B. sibbaldii* [= *B. musculus* (L.)]." As a fact, exactly the opposite is true. The average breadth of the rostrum at the middle in American specimens of *B. physalus*, as seen in a previous chapter (p. 133), is 19.6 % of the length of the skull. In the Ocean City skull the two maxillæ taken together, *without the premaxillæ or median interspace*, have a breadth at the middle of 19.2 % of the length of the skull. With a suitable allowance for the premaxillæ

[1] For a figure and brief description of this whale see *Around the World*, Jan., 1894, p. 40.

and interspace, the breadth of the rostrum is 28.8 %. It is obvious, therefore, that the rostrum is not acuminate as in *B. physalus*.

The second point of agreement between the Ocean City whale and *B. physalus* pointed out by Cope is in the number of vertebræ and ribs. He gives the following formula for the vertebræ: C. 7, D. 15, L. 17, Ca. 23 = 62. So far as the total number is concerned, this is the average for *B. physalus*, but the formula does not correspond with that of any specimen of the species with which I am acquainted. The formula for the Ocean City skeleton which I found in 1900 was as follows: C. 7, D. 15, L. 14, Ca. 24 + = 60 +. It was impossible to decide definitely as to the location of the first chevron, and fifteen lumbars should perhaps be counted, rather than fourteen. So far as it goes, this formula is not more characteristic of *B. physalus* than of *B. musculus*, but as the last caudal vertebra found had a transverse diameter of $4\frac{1}{2}$ inches and an antero-posterior diameter of $2\frac{3}{4}$ inches, it is probable that as many as four caudals should be added, making the total twenty-eight, a number never found in *B. physalus*.

The next point of agreement with *B. physalus* mentioned by Cope is the proportional size of the pectoral fin. According to my measurements of the Ocean City whale, the length of the pectoral from the tip to the root, or insertion, was 99 inches, while in a specimen of *B. physalus* $4\frac{1}{2}$ feet *longer* than the Ocean City whale the same dimension was but 72 inches.

As regards the position of the dorsal fin, I do not find any exact measurement either in Mr. Ives's table (cited by Cope) or my own. The remark that the "dorsal fin marks a point *about* one-fourth the length from the posterior border of the flukes to the end of the muzzle," would apply almost equally as well to *B. physalus* as to *B. musculus*. Indeed, as will be seen later, the relative position of the fin is so nearly the same in both species that it can scarcely be used as a diagnostic character.

From the foregoing facts it will be seen that the association of the Ocean City whale with *B. physalus* does not receive support. On the other hand, the small size of the dorsal fin, and the mottled gray color of the body, the large pectoral fin, and the dark under-surface of the flukes ally it to the Sulphurbottoms of Newfoundland.

I append the measurements of the Ocean City whale, made by myself, with those of Mr. Ives added. These measurements were made ten years before those of the Newfoundland specimens, and without reference to any particular system. They are not, therefore, strictly comparable with the latter:

BALÆNOPTERA MUSCULUS (L.). OCEAN CITY, N. J., OCTOBER 8, 1891. FEMALE.

Total length along the middle of the body from snout to notch of flukes	66 ft.	2 in.[1]
Length of pectoral in middle line	8 "	3 " [2]

[1] " To hinder border of the tail," 66 ft. 11 in. (Ives.)

[2] " From shoulder to the tip," 7 ft. 4 in.; " along the lower margin," 8 ft. 3 in.; " along the upper margin," 6 ft. (Ives.)

Length of pectoral along anterior border	8 ft.	8	in.
" " " " " " to termination of white under-surface	8 "	3	"
Greatest breadth of pectoral	2 "	2	"
Breadth of flukes	14 "	10	"
Distance from flukes to anus	20 "	0	"
Center of anus to center of navel	10 "	0	"
Breadth of caudal peduncle at insertion of flukes	1 "	8	"
Tip of mandible to corner of mouth (along the curves)	16 "	10	"
Corner of mouth to auricular orifice	3 "	6	"
Distance across the head	13 "	6	"
Length of auricular orifice	0 "	$2\frac{1}{2}$	"
" " the dorsal fin (Ives)	1 "	0	"
Height of the same (Ives)	0 "	5	"

It is an unfortunate fact that no complete reliable account of the osteology of *B. musculus* has been published, unless it be that of Malm. His *Monographie illustrée* is not accessible to me. Equally to be regretted is the fact that the measurements given by Flower (*45*), Reinhardt (*75*), and Malm (*66*) are not in accord. On that account a thorough comparison of the proportions of the skeleton cannot be made.

The osteological characters of *B. musculus* are summarized by Van Beneden (*7*, 260) as follows:

"This species is distinguished from other Balænopteras by the beak, which is very broad, especially at the middle of its length; by the nasal bones, truncated in front; and by the palatines, very broad. The upper jaw is exceeded by the lower, and the coronoid process is high and pointed; the vertebræ number 63 or 64; the ribs are 15 or 16 pairs in number; the sternum is broad and short; the metacarpals and phalanges are comparatively long."

NUMBER OF VERTEBRÆ.

The vertebral formulæ given by various European authors for *B. musculus* are as follows:

BALÆNOPTERA MUSCULUS (L.). EUROPEAN. VERTEBRAL FORMULA.

Author.	Locality.	Date.	C.	D.	L.	Ca.	Total.	Type of.
Flower	Humber R., England (Hull Museum)	1833	7	16	— 4	1[1] —	64[2]	*sibbaldii*
"	Coast of Holland (Utrecht Museum)	18—	7[1]	15	— 4	2[3, 1] —	64[2]	*latirostris*
Turner	Longniddry, Scotland	1869	7	15	— 4	1 —	63	(mature)
"	" "	"	7	15	— 4	1 —	63	(fœtus)
Malm	Gothenburg, Sweden	1865	7	15	15	26	63	*carolinæ*
Knox	North Berwick, Scotland	1831	7	15	— 4	3[4] —	65	
Möbius	Sylt Id., Germany	1881	7	16	15	26	64	

[1] According to Lahille, the formula for both is generally given as $7 + 16 + 15 + 26 = 64$; but Gervais says it should be $7 + 16 + 13 + 28 = 64$.

[2] "The two skeletons [Hull and Utrecht] agree in possessing sixty-four vertebræ, both being in this respect, fortunately complete" (Flower).

[3] Lumbars 15 or 16 (Flower, *45*, 410).

[4] Jardine, Nat. Library, Cetacea, has a figure of this skeleton on plate 6. The lumbars appear to be 16.

The only two complete formulæ are:

C. 7, D. 15, L. 15, Ca. 26 = 63,—Gothenburg.
C. 7, D. 16, L. 15, Ca. 26 = 64,—Kiel.

H. P. Gervais, without explaining how he arrived at the fact, remarks (*51*, m. 23), that "the vertebral formula given hitherto by the authors who have had occasion to observe and describe skeletons belonging to the species which occupies us [*B. musculus* (L.)] is the following: C. 7, D. 16, L. 15, Ca. 26 = 64." In contradiction it will be observed from the preceding table that the Hull Museum specimen, described by Flower, and the Sylt Id. specimen, described by Möbius, are the only ones reported as having sixteen pairs of ribs. Sir William Turner, than whom there is no more competent authority, reports fifteen pairs for both the adult and the fœtal Longniddry specimens.

Gervais, however, insists on sixteen pairs, and further states that the number of lumbars is thirteen, rather than fifteen. He bases this latter assertion on an examination of a skeleton from Cape Horn (which he assigns to this species) and two skeletons and a fœtus from Laponia. Gervais appears to have had in mind an ideal formula which he calls the *formule générale*, with which the various specimens would be found to agree if studied with sufficient care. I am far from believing that such would be the case, as it seems to be demonstrated that in the majority of cetaceans the number of vertebræ and their division into dorsals, lumbars, and caudals is subject to a certain amount of variation. Even in the specimen from Cape Horn which Gervais assigns to *B. musculus* the vertebral formula does not agree as regards number of caudals with his *formule générale*.

Supposing Turner, Flower, Gervais, Malm, and Möbius all to have been correct, we should have a variation for the European *B. musculus*, as follows:

(1) C. 7, D. 16, L. 13, Ca. 28 = 64.
(2) C. 7, D. 16, L. 15, Ca. 26 = 64.
(3) C. 7, D. 15, L. 15, Ca. 26 = 63.

So far as adult North American specimens are concerned, we have for comparison only the Ocean City whale, but while at the Newfoundland Station I examined and counted the vertebræ of three fœtal specimens. The formulæ for these and the Ocean City whale are given below.

It will be remarked that the three formulæ from Newfoundland fœtuses are

BALÆNOPTERA MUSCULUS (L.). AMERICAN. VERTEBRAL FORMULA.

No.	Locality.	Date.	C.	D.	L.	Ca.	Total.	
1	Balena, Newfoundland	1901	7	16	15	27	65	fœtus ♀
14	" "	1901	7	15	14	28	64	" ♀
19	" "	1901	7	15	16	26	64[1]	" ♀
	Ocean City, New Jersey	1891	7	15	14[2]	24(+4?)	60(+4?)	

[1] Positively correct! [2] Perhaps fifteen lumbars should be counted. It is uncertain.

all different. I believe them all to be correct, but that for No. 19 is certainly so, as it was obtained by very careful dissection of the fœtus, after I had observed that the formulæ for the two preceding specimens did not agree.

It will be noted that the formula for No. 1 is the same as for the Kiel specimen, except that the latter has one less caudal vertebra. The formula of No. 14 does not agree with any of the European specimens, but would accord with Gervais's *formule générale*, if one vertebra were taken from the lumbar series and added to the dorsals. The formula of No. 19 is remarkable for the sixteen lumbars.[1] The formula for the Ocean City whale is based on my own observations, but, as already stated, one vertebra should perhaps be taken from the caudal series and added to the lumbars, making fifteen lumbars in all, in which case this specimen, in so far as it is complete, would agree with Malm's *B. carolinæ*. However this may be, as the last rib present is long, it is quite probable that one more pair, making sixteen in all, was present originally. In this case the number of lumbars might be considered as reduced to thirteen, thus according with Gervais's views. The Ocean City skeleton probably lacks one caudal between the sixteenth and seventeenth (*i. e.*, between the fifty-second and fifty-third vertebræ as now placed), and probably the number of terminal caudals lacking is three.

Until the limits of variation in the number and division of the vertebræ in *B. musculus* are better determined, little reliance can be placed on the formulæ for the discrimination of the species from its nearest allies. The present indications are that the amount of variation is considerable.

In this connection, it is interesting to observe the lack of harmony in the vertebral formulæ given for the South American Sulphurbottom. Gervais, who regards the southern species as the same as *B. sibbaldii* [= *B. musculus* (L.)] gives the formula C. 7, D. 16, L. 13, Ca. 29 (or 30) = 65 (or 66). Burmeister's *B. intermedia*, regarded the same as *B. musculus* both by Gervais (*51*, m. 6) and by Lahille (*63*, 35), has, according to the original describer, the formula C. 7, D. 15, L. 16, Ca. 27 = 65. Lahille's Sulphurbottom, which he regards as a separate species, *B. miramaris*, has the formula C. 7, D. 14, L. 14, Ca. 29 = 64.

In the Ocean City skeleton the first vertebra in which the transverse process is perforated, or has a foramen at the base, is the forty-sixth (right side only). The transverse processes are last distinguishable on the forty-eighth vertebra, and the neural arch is obsolete on the fifty-fifth vertebra.

SKULL.

For the reasons stated on p. 179, a complete comparison of measurements of the skulls of European and American specimens can not be made. The figure of the skull of the Iceland whale published by Reinhardt (*75*, 188) appears to be accurate, except that the maxillæ have sprung apart. Measurements made on this figure compared with those from the skull of the Ocean City whale show a close agreement, as follows:

[1] Van Beneden (*7*, 265) gives the formula of a skeleton at Edinburgh as 7, 15, 16, 25 = 63. He states in another place that there are bones of four individuals in Edinburgh, including the North Berwick whale (*7*, 280).

BALÆNOPTERA MUSCULUS (L.). NEW JERSEY AND ICELAND. SKULL.

Measurement.	Ocean City, New Jersey.	Iceland.
Greatest breadth of skull	99.0 in.	103.5 in.
Breadth of the maxillæ at the middle	17.5 "	20.3 "
Length of the rostrum without premaxillæ	115.5 "	130.5 "
Breadth of distal end of frontal over the orbit (greatest).	18.0 "	22.5 "

The principal cranial characters of *B. musculus*, the broad maxillæ and thick, obtuse nasals, are found in the Ocean City whale. The nasal bones were not in the skull when I examined it in 1900, but they are described by Cope as follows: "The nasal bones have a parallelogrammic superior outline, but are very convex in the fore-and-aft direction, the surface descending forward. They are flat posteriorly; at the middle the adjacent edges are raised, but at the distal end the external edges are raised, so that the superior surface is concave in the transverse direction" (*31*). It will be observed that this agrees with the excellent figure of the nasals published by Reinhardt (*75*, 187). This figure is one-ninth natural size. The two nasals together are shown to be 7.9 in. wide at the proximal end, and 9.25 in. wide at the distal end. The nasals in a cranium at the Newfoundland station were 10 in. wide at the proximal end and 10.75 in. wide at the distal end. They are figured in pl. 7, fig. 10. In Münter's Rügen Id. specimen they measured 6.9 in. at the proximal end and 7 in. at the distal end.

The breadth of one of the maxillæ at the middle of its length, compared with the length of the same bone, is 12.7 % in the Iceland whale (Reinhardt), 12.8 % in the Hull whale (Flower), and 13.5 % in the Ocean City whale. Other measurements of the Ocean City whale are as follows:

BALÆNOPTERA MUSCULUS (L.). OCEAN CITY, N. J., OCTOBER 1891.

Length of skull, straight	14 ft.	7½ in.	[1]
Greatest breadth, squamosal	7 "	3 "	
Breadth of orbital process of frontal at distal end	0 "	11½ "	[2]
Length of rostrum, straight	9 "	7½ "	[3]
Breadth of rostrum at middle, curved	1 "	5½ "	[4]
Length of mandible, straight	15 "	2 "	
" " " curved	17 "	1 "	
Depth " " at middle	1 "	1 "	
Greatest breadth of axis	3 "	0 "	
Depth of centrum of axis	0 "	10 "	
Greatest breadth of 1st dorsal	2 "	10 "	
Depth of centrum of " "	0 "	10½ "	
Greatest breadth of 1st lumbar	3 "	11 "	
Depth of centrum of " "	0 "	12½ "	
Greatest breadth of 1st caudal	3 "	0 "	
Depth of centrum of " "	1 "	2½ "	
Greatest breadth of scapula	4 "	1½ "	
" depth " "	2 "	6 "	
Length of radius, without epiphyses	2 "	8½ "	
" " ulna " "	2 "	6 "	[5]
Breadth of radius at distal end	0 "	10 "	
" " ulna " " "	0 "	8 "	

[1] Estimated. Add 8½ in. for premaxillæ.
[2] Least. The greatest is 18 in.
[3] Without premaxillæ.
[4] Breadth of maxilla only.
[5] The greatest = 34½ in.

Vertebræ: 7, 15, 14, 24 + = 60 +; several lacking. The last present measures $4\frac{1}{2}'' \times 4\frac{1}{2}''$ and is $2\frac{3}{4}''$ thick antero-posteriorly. Fifteen should perhaps be counted as lumbars. It is uncertain.

RIBS.[1]

The Ocean City whale has 15 pairs of ribs. The majority of specimens of *B. musculus* thus far described have this number, as will be seen by reference to the table on p. 181. Gervais, however, insists that the number should be 16 pairs, and that when less are reported it is because the last pair is overlooked. This hardly seems probable in view of the variability known to exist in all species of cetaceans. It was not the case in the Newfoundland fœtuses which I examined, two of which had 15 pairs of ribs and one 16 pairs.

In the Ocean City whale, the 2d, 3d, and 4th ribs have capitular processes. In *B. musculus*, according to Van Beneden and Gervais (*8*, 215), the 3d and 4th ribs are furnished with a neck (*col*). This information is probably from Malm. Of the Hull museum skeleton Flower remarks (*45*, 412): "The 2d and 3d ribs have both well-developed capitular processes extending towards the bodies of the vertebræ, longer and more slender in the third. In the 4th this process is nearly obsolete, and absent in all the succeeding ones."

The 1st rib in the Ocean City whale, as normally in *B. musculus*, is single-headed. It is to be remarked, however, that the 1st rib in the Ostend, Belgium, skeleton, according to Dubar's figure and description, is double-headed (*34*, 38, pl. 8).

The following table includes measurements of the ribs of various European specimens and of the Ocean City, New Jersey, skeleton:

BALÆNOPTERA MUSCULUS (L.). EUROPEAN AND AMERICAN. RIBS.

Locality.	Length of Whale.	Length of Skeleton.	Length of				Author.
			1st Rib.	2d Rib.	3d Rib.	6th Rib.	
			in.	in.	in.	in.	
Ostend, Belgium.....	.....	.....	97.6 (= 2.48 m.)	82.7 (=2.1 m.)	.....	.....	Dubar
N. Berwick, Scotland.	.....	78′	.....	.....	.....	46	Knox
Holland.....	50′ ±	46′ ±	.....	49.0	59.0	.....	Flower
Baltic Sea (1862).....	51′ 8″	.....	40.0	.....	.....	.....	Münter
Sylt Id., Germany....	50′ 0″	43′ 0″	.....	.....	.....	59 8	Möbius
Ocean City, N. J.....	66′ 2″	.....	51.0[2]	.....	.....	.....	Cope

SCAPULA.

The only illustrations of the scapula of the European Sulphurbottom accessible are Dubar's (*34*, pl. 10), which is obviously inaccurate, and the figure copied by Van Beneden and Gervais from Malm's illustrations of "*B. carolinæ*" (*8*, pls. 12–13, fig. 33). Outlines of these figures and of one of the scapulæ of the Ocean City, N.

[1] No material is available for a comparison of the sternum of the European Sulphurbottom with American specimens. Text-figures 49 and 50 show the form in two European examples.

[2] Breadth at distal end, $9\frac{1}{2}$ in.

J., specimen, and of a scapula which I photographed at Balena whaling station, are shown in the accompanying text figures 45 to 48. See also pl. 7, figs. 5 and 6.

FIG. 45.

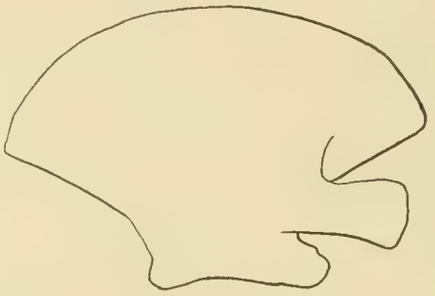


FIG. 46.

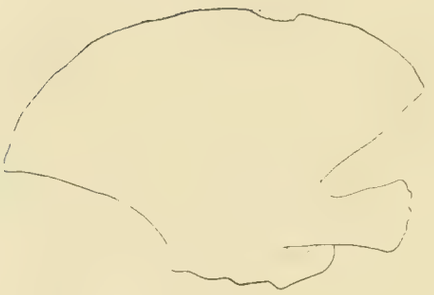


FIG. 47.

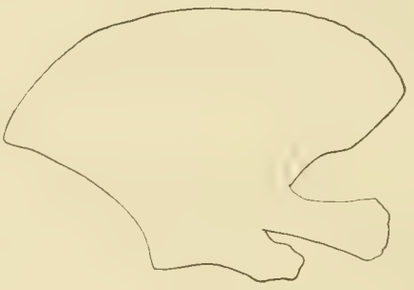


FIG. 48.

SCAPULA OF *BALÆNOPTERA MUSCULUS* (L.).

FIG. 45.—OSTEND, BELGIUM. AD. ♀. (FROM DUBAR.) FIG. 46.—SWEDEN. (FROM VAN BENEDEN AND GERVAIS.) FIG. 47.—BALENA STATION, NEWFOUNDLAND. AD. (FROM A PHOTOGRAPH.) FIG. 48.—OCEAN CITY, NEW JERSEY. IM. ♀. (FROM A PHOTOGRAPH.)

These figures show the strongly projecting anterior and posterior borders, evenly convex superior border, and large acromion, characteristic of the Sulphurbottoms. What the range of variation in form may be in European and American specimens, and whether specific differences could be detected, cannot of course be determined at present for lack of material. It is to be expected that considerable individual variation will be found, and this is indicated in the two figures of scapulæ from American specimens, which while agreeing in general form, show differences in detail.

The dimensions of scapulæ in different specimens and the proportion of the breadth to the height in the same are shown in the table on p. 187. The discrepancy in proportions, amounting to about 4 per cent., I am unable to account for. It affects both the American and European specimens and is not, apparently, due to difference in age or sex. The diameter of the glenoid fossa in the scapula of the Ocean City skeleton is 13 in. by 9½ in.; the greatest length of the acromion is 16 in.

BALÆNOPTERA MUSCULUS (L.). EUROPEAN AND AMERICAN. SCAPULA.

Locality.	Sex.	Total Length.	Length of Skeleton.	Scapula.			Author.
				Breadth.	Height.	Proportion of Height to Breadth.	
		ft. in.	ft. in.	in.	in.	%	
Holland	..	50 ±	46 ±	35.5	21.0	60	Flower.
Baltic (1862)	♂	.....	.....	38.25 [1]	23.5 [1]	61.4	Münter.
North Berwick, Scotland	..	.....	78 0	60	38	63.3	Knox.
Gothenburg, Sweden	♂	51 7	49 7	.....	.....	64.4 [2]	Van Beneden and Gervais.
Sylt, Germany	♀	50 0 [1]	43 0	31	20	64.4	Möbius.
Ostend, Belgium	♀	.....	.....	69.3	42.1	60.0	Dubar.
Balena Station, Newfoundland	..	.....	.....	61	38.5	63.1	F. W. T.
Ocean City, N. J.	♀	66 2	.....	49.5	30.0	60.6	F. W. T.

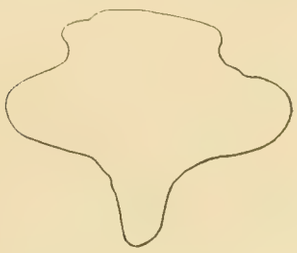


FIG. 49.

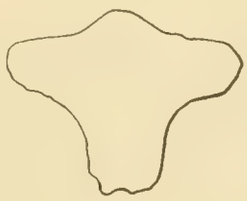


FIG. 50.

BALÆNOPTERA MUSCULUS (L.). EUROPEAN. STERNUM.

FIG. 49.—(STOCKHOLM MUSEUM. FROM VAN BENEDEN.) FIG. 50.—OSTEND, BELGIUM. ♀ AD. (FROM FISCHER.) (SEE P. 185, FOOT-NOTE.)

RADIUS AND ULNA.

The radius in the Sulphurbottom is remarkable for its breadth, and the ulna for its strong curvature. In Van Beneden and Gervais's copy of Malm's figure of the Gothenburg specimen (*8*, pl. 13, fig. 34) and in Dubar's figure (*34*, pl. 11) the ulna is represented as having a long olecranon process directed downward instead of upward. If this were correct it would at once distinguish the European from the Newfoundland Sulphurbottom, which has an erect or proximally-directed olecranon, as in *B. physalus*. It would appear that the process shown in the figures above mentioned is the cartilage attached to the olecranon, which may be ossified in such mature individuals as the Ostend specimen. Gervais's figure of the South American Sulphurbottom represents the process correctly as cartilage (*51*, pl. 1, fig. 3). With the exception mentioned, the figures of the arm-bones of European Sulphurbottoms agree well with those of the Ocean City, N. J., and Newfoundland specimens shown in pl. 7, figs. 7–9.

The following actual measurements of the arm-bones are given by various authors:

[1] Rheinland measure.

[2] From Van Beneden and Gervais's copy of Malm's figure.

BALÆNOPTERA MUSCULUS (L.). EUROPEAN AND AMERICAN. UPPER ARM-BONES.

Locality.	Length of Whale.	Length of Skeleton.	Radius.			Ulna.			Author.
			Length.	Breadth at Prox. End.	Breadth at Distal End.	Length.	Breadth at Prox. End.	Breadth at Distal End.	
	ft. in.	ft. in.	in.	in.	in.	in.	in.	in.	
Holland.....	50 ±	46 ±	27.0	6.0	7.5	25.0	7.0	5.5	Flower
Baltic (1862).....	51 8	.....	....	.....	.....	28.6	7.7	6.2	Münter
N. Berwick, Scotland	.....	78 0	46.0	.....	.....	....	.....	.....	Knox
Gothenburg, Sweden	51 7	49 7	29.1[1]	7.5	8.7	27.2[2]	7.7[3]	6.8	Malm
Sylt Id., Germany...	50 0[4]	43 0	....	.....	.....	....	.....	.....	Möbius
Ostend, Belgium....	.....	.....	48.0	.....	.....	48.0	.....	9.3[5]	Dubar
Ocean City, N. J....	66 .2	.....	32 5	.....	10.0	34.5[6]	9.3[7]	8.0	F. W. T.
Newfoundland.....	.....	.....	....	.....	.....	42.0[8]	12.5	9.25	F. W. T.

PHALANGES.

The number of phalanges in the European specimens of *B. musculus* described by various authors is as follows:

BALÆNOPTERA MUSCULUS (L.). EUROPEAN. PHALANGES.

Locality.	Author.	Length.	II.	III.	IV.	V.	Remarks.
Gothenburg.....	Malm	51′ 7″	4	7	7	3	Uncertain.[9]
Ostend.....	Dubar	85′ 0″ ±	4	7	6	4	
Iceland.....	Reinhardt	.....	4	6	6	3	
.....	Weber	.....	4	6	6	3	fœtus, 2.27 m.
Humber River....	Flower	50′ 0″	4	6	5	3	
Coast of Holland.	"	50′ 0″ ±	4	5	5	3	Uncertain.[10]

The Ocean City whale had the following formula, according to Cope (*31*): 4, 6, 5, 3. The phalanges in a Newfoundland fœtus (from No. 14, left side) are as follows: 5, 8, 7, 4.

SUMMARY.

The results of the foregoing discussion of American and European Sulphur-bottoms may be summed up as follows:

1. The average and maximum lengths of Norwegian specimens are greater than those of Newfoundland specimens, which may be an actual difference or may result from a difference in the system of measurements. As the same discrepancy is

[1] "In front." "Behind" = 26.2 in.
[2] "Behind," incl. olecranon, which is 6.9 in. "In front" = 25 in.
[3] Including breadth of olecranon, which is 2.2 in.
[4] German measure.
[5] From Dubar's figure.
[6] Including olecranon.
[7] From a photograph.
[8] Exclusive of olecranon, which is about 7 in.
[9] "De likaledes fullständiga fingrarna."
[10] "Artificially articulated."

found in the case of both *B. physalus* and *Megaptera*, the latter hypothesis appears more probable.

2. In external proportions, so far as may be judged from the limited data available in the case of European specimens, there is a very close correspondence between the Sulphurbottoms of the Eastern and Western North Atlantic, amounting to identity.

3. In coloration no important difference is exhibited.

4. The whalebone is of the same color in both American and European specimens and, so far as may be judged, of equal length.

5. The lack of records and material precludes a judgment as to osteological characters, though in such matters as the total number of vertebræ and ribs, general shape and size of the individual bones of the skull, shape of the scapula, etc., there is no clear indication of specific differences. Cope's suspicions that the Ocean City, New Jersey, specimen represented a species intermediate between *B. physalus* and *B. musculus* are not confirmed.

Viewing the present evidence as a whole there appears to be no reason for separating the American Sulphurbottom from *B. musculus* (L.).

THE REPRESENTATIVE OF *B. MUSCULUS* (L.) IN GREENLAND WATERS.

As mentioned on a previous page, Robert Brown and others assert that the Greenlanders recognize two or more species of large Finbacks under the name of *Tunnolik*. Fabricius (*41*, 35) identified the *Tunnolik* with *B. physalus* (L.) and gave a diagnosis and a few data regarding its habits and utilization. These standing by themselves are insufficient for the determination of the species and of no value in a case where the discrimination of closely allied forms is involved.

Scoresby (*84*, 1, p. 481) mentions a "Physalis found dead in Davis' Strait," which was 105 ft. long. Although the length is exaggerated, this specimen is probably to be assigned to *B. musculus*, as he states that the color was "bluish-black on the back and bluish-gray on the belly." The data he gives are insufficient for a positive identification.

In 1846 Eschricht (*36*, 373) published a description and measurements of a female *Tunnolik* stranded at Godhavn, August 12, 1843, which account he obtained from H. P. C. Möller who examined the specimen. Möller's description contains the following data:

Body more elongate than in *Balæna mysticetus*, *Megaptera longimana*, or *Balænoptera acuto-rostrata*.

Fore part of body thick and heavy; hind part slender and thin, much compressed.

Color black throughout, or possibly lighter under the posterior part of the body; within folds of the skin, *e.g.*, about mammæ, or genitals, dark mouse-gray.

Pectorals white below.

Upper jaw a foot shorter than the lower. Lower jaw with a rounded terminal protuberance and faint median keel.

Baleen very short and proportionately very broad.

Dorsal fin unusually small and thin and situated behind the line of the genital orifice.

The dorsal fin of this specimen was sent to Eschricht in salt, and is described by him as follows (*36*, 378):

"The fin itself, extremely small (4 inches high) and flat and narrow, with the point curved backward, stood on a thick tuberous root, which apparently might be regarded as the base of the fin."

Eschricht also received from Möller one of the pectoral fins, of which he gives a description and figure (*36*, 379). He found that it was quite different in form from the pectorals of the Humpback and Little Piked whale, and that the phalanges were 5, 5, 6, 3. Its length was $\frac{1}{6}$ the total length of the whale.

Möller's measurements of the exterior were as follows:

	Ft.	In.
From tip of mandible to notch of flukes (straight)	68	0
" " " " genitalia	46	0
" " " " navel	36	0
From notch of flukes to dorsal fin	14	0
" " " " " middle of genital slit	20	6
" " " " " mammæ	21	6
" " " " " navel	36	0
" " " " " pectorals	42	0
From genital slit to navel	15	0
" " " " swollen part of body	12	0
Length of genital slit	1	6
Distance between fore part of pectorals	1	0
" " mammæ	1	7
Length of pectorals	7	6[1]
Greatest breadth of pectorals	3	4
Distance between outermost points of flukes	16	0
Flukes from notch to root	3	6
Length of largest baleen (about)	4	0
Breadth of largest baleen	1 ft. 1 in. to 1	2
Height of dorsal fin	0	4

While considering that the identity of this specimen could not be positively determined, Eschricht, with his usual sagacity, reached the conclusion that it was probably the same as the celebrated Ostend specimen. In this he was entirely justified. The Ostend specimen is now known to have been a Sulphurbottom, *B. musculus* (L.).

Möller's measurements, reduced to percentages of the total length and compared with the average of the ten Newfoundland females of *B. musculus*, measured by myself, are as follows:

[1] The pectoral preserved in the Copenhagen Museum measures 11¼ ft.—ESCHRICHT.

BALÆNOPTERA MUSCULUS (L.). GREENLAND AND NEWFOUNDLAND.

Measurement.	Godhavn, Greenland.	10 Newfoundland Females. Average.
Total length	68′ [1]	
Snout to posterior base of dorsal	78.9 %	(5) 77.2 %
Notch of flukes to clitoris	30.0 [2]	30.6
Length of pectoral from axilla	11.3	10.5
" " " " head of humerus	16.9	15.4
Greatest breadth of pectoral	5.0	4.9
Height of dorsal	0.5	(11) 1.2

The correspondence between these measurements is sufficient to show that the Greenland specimen is at least very close to the Newfoundland Sulphurbottom, if not identical with it, which probability is strengthened by many points in Möller's description. The chief differences shown here and in the other data given by Möller are: (1) the dorsal fin is lower; (2) the color is black.

Regarding these points it may be said, first, that in view of Eschricht's remarks regarding the dorsal fin, it is uncertain whether Möller measured the height in the same manner as myself; second, Möller's specimen had been dead three days when he saw it and perhaps much longer, so that it is quite natural it should be described as black. It is to be noted that the parts protected from the light are described as gray.

The case of this Greenland specimen (and the species it represents) remains, therefore, substantially as Eschricht left it, namely, with a very strong probability that it was identical with *B. musculus* (L.), but with positive determination impossible from lack of more extended data.

[1] This length is from the tip of the mandible to the notch of the flukes. In computing the percentages here and on p. 159, eighteen inches were subtracted for the overhang of the lower jaw.

[2] To the middle of the genital orifice.

CHAPTER VI.

THE LITTLE PIKED WHALE, *BALÆNOPTERA ACUTO-ROSTRATA* LACÉPÈDE.

Sars's diagnosis of this species is as follows:

1. Length of full-grown individuals 20 to 30 feet. (Maximum 36 feet—Van Beneden.)
2. Body less slender than in the other species of the genus, the greatest depth equalling $\frac{1}{5}$ the length; behind the navel gradually narrower; tail with a rather high crest above and below.
3. Color above and on the sides of the lower jaw gray-black; below white; dark color of the back descending obliquely behind the pectoral fins and occupying the greater part of the tail.
4. Length of the mouth exceeding $\frac{1}{5}$ the total length; upper jaw seen from above, becoming attenuated rapidly from the base, with the extremity acute, pale gray.
5. Pectoral fins small, scarcely exceeding $\frac{1}{8}$ the total length, lanceolate, forming an obtuse angle posteriorly at about the middle of the length; the middle of the external surface with a broad transverse band of pure white, sharply defined proximally, less so distally; base and tip black.
6. Dorsal fin quite high, with the tip strongly curved backward, like a horn. It lies quite far forward with the anterior insertion at the commencement of the last third of the total length, and in advance of a vertical line drawn through the anus.
7. Flukes below whitish, with irregular dark markings.
8. Baleen entirely yellowish-white (*79*, 15).

Plate 1 accompanying Sars's memoir represents a female 14½ ft. long, captured near Christiania, Norway, September, 1878. The original drawing was by Sars. It is an admirable figure in every respect, and corresponds exactly with the foregoing diagnosis.

Dr. Collett added the following characters in the diagnosis of the species given by him in 1886: "Number of plates [of baleen] about 325; their greatest length about 200 mm., not including the bristles." "Inner side [of the flippers] quite white" (*21*, 264). Bocourt's figure of the Bretagne specimen (*49*, pl. 3), which is in most respects very satisfactory, shows a broader white band on the under surface of the pectoral than on the upper surface, with the margins nearly as well defined.

As I am acquainted with but three specimens from the east coast of the United States which may be supposed to represent *B. acuto-rostrata*, I am unable to speak with any great degree of confidence regarding the matter of identity in this case. The three specimens referred to are as follows:

(1) A skeleton 16 ft. 5½ in. long from off Monomoy Pt. Lighthouse, Harwichport, Massachusetts, in the U. S. National Museum. (No. 20931, from the U. S. Fish Commission, 1883.)

(2) Measurements, description, and sketches of a female, 15 ft. 4 in., entangled in the nets of the fishermen near Portland, Maine, in July, 1893, and exhibited in that city. I owe the data relating to this specimen to Joseph P. Thompson, Esq., Vice-President of the Portland Society of Natural History.

(3) Two photographs of a female, 22 ft. 8 in. long, captured near Quoddy Head Life-saving Station, Maine, Sept. 6, 1889, and reported to the Smithsonian Institution by Capt. A. H. Myers, keeper of the station.

An imperfect skull was dredged up near Pigeon Cove, Mass., in 1881, and sent to the National Museum, by Mr. Wm. H. Jackson. It is not now accessible. (No. 23025.)

The sketch of the exterior of the Portland specimen (text fig. 51) shows that

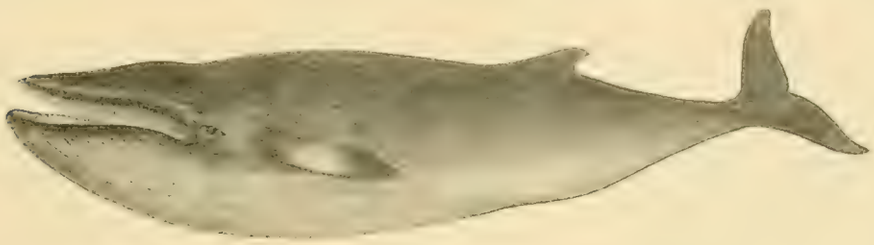


FIG. 51.

FIG. 52.

BALÆNOPTERA ACUTO-ROSTRATA LAC. PORTLAND, MAINE.

FIG. 51.—FEMALE, LENGTH 15 FT. 4 IN. FIG. 52.—LEFT PECTORAL FIN OF THE SAME. EXTERNAL SURFACE. (FROM SKETCHES BY JOSEPH P. THOMPSON, ESQ.)

it corresponds with the diagnosis of *B. acuto-rostrata* as regards the general form, and in the form of the dorsal and pectoral fins. The color markings on the external face of the pectoral fin are exactly as in that species, as is shown by Mr. Thompson's excellent figure (text fig. 52). His notes on this specimen are as follows: "The color of the body was an ashy black above, passing into a pure white on the belly, without any distinct demarkations; nor was there any apparent lateral line. The blowhole was in a sunken cavity. The eye was very near the corner of the mouth. The number of longitudinal furrows could not be accurately counted, though they were very strongly marked, of a pinkish color within the folds, and white without. The baleen was of a pinkish brown at the bases of the plates and fading in color

to a dirty white at the free, fringed extremities. The snout was quite pointed and evidently the upper jaw when closed fitted into a deep groove in the lower, which was considerably longer and projected beyond the upper." The colors of the body and of the whalebone are those of *B. acuto-rostrata.*

Mr. Thompson made the following measurements on the Portland specimen:

Total length, end of snout to forking of the flukes	15 ft. 4 in.
Approximate girth at deepest point (this could not be accurately taken)	9 " 0 "
Pectoral fin (left side), length	2 " 2 "
" " greatest width	0 " 7 "
" " distant from corner of mouth	2 " 1 "
Dorsal fin, length obliquely	1 " 0 "
" " height approximately	0 " 8 "
" " distant from fork of flukes	5 " 1 "
Caudal fin, extreme width, point to point	4 " 2 "
" " from fork to anus	4 " 3 "
End of snout to spiracles	2 " 6 "
" " " " corner of mouth (upper jaw)	2 " 8 "
" " " " " " " (lower jaw)	3 " 3 "

While these measurements show a reasonably close approximation to those of *B. acuto-rostrata* given by various European authors, the latter unfortunately present so little uniformity among themselves that they are hardly available for the discrimination of closely allied species. The measurements of ten specimens from the coasts of France and Great Britain, and those for the Portland specimen and the New York specimen cited by DeKay in 1842 (*32*, 130), are given below. For convenience of comparison they are all reduced to percentages of the total length.

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN.

	Granton, Scotland, 1788. (Turner, 1872.)	Vergeroux, France, 1835. Charente River. (Lesson, 1841.)	St. Jean de Luz, France, 1863. (Fischer, 1881.)	Scalpa Bay, Orkney Islands, 1808. (Scoresby, 1820.)	Dogger Bank, North Sea, 1763. (Hunter, 1787.)	Cherbourg, France, 1791. (Fr. Cuvier, 1836.)	Drogheda, Ireland, 1863. (Carte and Macalister, 1868.)	Weymouth, England, 1370. (Perrin, 1870.)	Fécamp, France, 1883. (Lennier, 1885.)	Queensferry, Scotland, 1834. (Knox, 1857.)	New York Bay, 1822. (Dekay, 1842.)	Portland, Maine, 1893. (J. P. Thompson.)
Sex and age	♀ ad.	♂ adol.		♀	♀ jr.	♀ jr.	♀	♀ jr.	jr.	jr.	♀?	♀?
Total length	28′ 4″[1]	24′ 6″	21′ 8″	17′ 6″	17′ 0″	14′ 0″[4]	13′ 11″	13′ 5″[7]	11′ 11″	9′ 11″	18′ 0″	15′ 4″
	%	%	%	%	%	%	%	%	%	%	%	%
Tip upper jaw to eye	....	....	....	20.0	19.1	21.4	15.3	19.6	....	....	....	...
" " " " blowhole	13.3	....	....	17.1	(14.2)	....	....	13.6	....	13.5	....	....
" " " " pectoral	....	....	....	28.6	35.5	(32.1)	27.8	30.4	....	27.7	....	....
" " " " back of dorsal	70.0	74.6	. ..	(78.6)	(72.6)	....	(68.9)	74.8	....	71.5	....	66.9
Tip lower jaw to corner mouth	16.5	....	....	....	(20.7)	....	17.6	....	....	....	19.5?	21.2
" " " " navel	....	....	....	...	50.0	....	...	....	...	...	....	....
Length of pectoral (from axilla?)	15.3[2]	9.3	....	11.5	14.7	14.3	12.3[5]	(14.8)	12.7	12.6[8]	11.6	14.1
Greatest breadth of pectoral	3.8[3]	....	....	3.3	3.0	3.6	3.4	....	....	....	....	3.8
Height of dorsal	3.5	4.3	....	7.1	...	6.0	3.3	3.7	5.3	7.1	5.5	4.4±
Flukes from tip to tip	26.0[3]	....	25.5	....	29.4	....	18.2[6]	27.6	21.0	27.3	26.4	27.2

[1] Straight, to posterior margin of flukes.
[2] Ant. border, curved. (From axilla, straight = 9.3 %.)
[3] Straight.
[4] French measure.
[5] Length " external to integuments."
[6] This measurement must be erroneous.
[7] To " extremity of tail," straight; along curve of back = 13′ 8½″.
[8] Length of " inner side."

The most notable discrepancy between the Portland specimen and those from the European coasts is, perhaps, that the distance from the snout to the posterior margin of the dorsal fin in the former is but 66.9% of the total length, while with one exception this distance exceeds 70% in the European specimens. It is true that this distance for the Drogheda, Ireland, specimen, computed from the measurements given by Carte and Macalister (*14*), is but 68.9% of the total length, but too much reliance cannot be placed on the measurements of this specimen. That for the flukes is obviously inaccurate.[1]

All that can be learned from the foregoing table is that the proportions of the European and American specimens show an approximate agreement.[2]

The photographs of the specimen from Quoddy Head, Maine, reproduced in plate 28, figs. 3 and 4, show in an admirable manner the stout body, prominent caudal ridges, sharp head, and strongly curved dorsal fin characteristic of *B. acutorostrata*. They show also that the center of the pectoral fin above and the center

[1] It is also to be observed that their figure of the exterior, stated to be "made to the scale of 1 inch to the foot," is not on that scale, and does not agree in proportions with their measurements. They were aware, however, of the discrepancies in the position of the dorsal fin as given by earlier authors.

[2] Since the foregoing paragraphs were written, I have received from Mr. J. Henry Blake of Cambridge, Mass., some valuable notes on Cetacea observed on the New England coast, including measurements of a young whale of the present species. These measurements, together with percentages of the total length of such as are comparable with those of the foregoing table, are as follows:

Measurement.	Ft.	in.	Per cent.
Length from end of lower jaw to notch of flukes (upper jaw little shorter)	14	6	100.0
End of jaw to center of eye	2	7	18.0
Length of eye	0	2¼	.....
Eye to shoulder joint	1	9	.....
" " blowholes	1	1	.....
" " ear	0	9¼	.....
Ear to shoulder joint	0	10	.....
" " axilla	1	1½	.....
End of upper jaw to hind part of blowholes	2	4	.....
Blowholes to dorsal fin	7	2	.....
Length of mouth from end of lower jaw	2	0	13.8
" " pectoral from axilla to tip	1	6	10.4
" " " " shoulder joint to tip	2	4	.....
" " " " axilla to forward outer edge	0	10	.....
Shoulder joint to forward part of flukes	9	0	.....
Median line of back to pectoral fin	1	5	.....
Width of pectoral fin	0	7	4.0
Height of dorsal fin	0	7	4.0
Length " " "	0	11	.....
Dorsal fin to forward part of flukes	3	8	.....
Forward to hind part of flukes at base	1	2	8.0
Flukes from tip to tip	4	2	28.7
Navel to forward part of flukes	5	7	.....
Genitals to " " " "	3	2	.....
Height of body at dorsal fin	2	11	.....
Greatest girth (just below pectoral fin)	7	3	.....
Tip of upper jaw to hind margin of dorsal fin	.....		71.8

Blowholes situated 2 in. in front of a perpendicular line from the eye.
Ear situated just above a line drawn from the eye to the pectoral fin.
Number of abdominal folds, 50.
Baleen pure white, 7 in. long.

of the flukes below are white. The under surface of the body is also white, and the baleen is light-colored. The gular folds are about 60 in number, as in *B. acuto-rostrata.*

The photographs agree well with the figure of *B. acuto-rostrata* (also from a photograph) published by Sir Wm. Turner (*92*, 41, fig. 1), though the latter is unfortunately rather indistinct. The outward curve of the gular folds at the posterior end is, however, well shown in both. Sir Wm. Turner states that in the Granton specimen the white area of the upper surface of the pectoral was interspersed with black blotches (*92*, 49). This would appear to have been the case with the Quoddy Head specimen, but the photograph is unfortunately taken from such a point of view that the upper surface of the pectoral cannot be well seen. In Bocourt's figure the white is unspotted.

SIZE.

The maximum size of *B. acuto-rostrata* is given by various authors as 36 feet, but I am not certain that this rests on actual measurements of specimens. Eschricht states that the *Vaagehval* may bear young when 23 ft. (Rheinland) long, and is certainly full-grown when 27 to 29 ft. long (*37*, 170), and again that the mature individuals, 24 to 29 or 30 ft. long, taken at the station near Bergen are as a rule pregnant. The largest with which he was acquainted was the one stranded in the Weser River, Germany, in 1669, which was 26⅔ ft. long (Rheinland measure =27 ft. 5½ in., Eng.), and Lesson's specimen found at the mouth of the Charente River, France, in 1835, which was 7.48 m., or 24 ft. 6 in. (Eng.) long. Turner's Granton, Scotland, female was 28 ft. 4 in. long, and appears to be, therefore, the largest recorded specimen. This was measured to the posterior margin of the flukes.

No full-grown American specimens have been recorded.

OSTEOLOGICAL CHARACTERS.

The data for the comparison of osteological characters are fuller and more satisfactory. Van Beneden and Gervais (*8*), Van Bambeke (*1*), Carte and Macalister (*14*), and other writers have given detailed descriptions of the skeletons of European specimens of *B. acuto-rostrata*, and Sir William Turner has published (*92*, 68) an admirable table of measurements of five skulls preserved in the Museum of the University of Edinburgh, and has corrected errors in the observations of earlier writers regarding these same specimens.

SKULL.

In comparing the dimensions of the skull of the Massachusetts specimen with those of European specimens, we have been able to make use of Turner's table and also to personally measure a skull (No. 13877) belonging to a skeleton in the National Museum, from the coast of Norway. These measurements, with others, I have reduced to percentages of the total length, and brought together with those of the Massachusetts specimen, similarly treated, in the following table:

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN. SKULL.

	Queensferry, Scotland. Univ. of Edinburgh, 1834. (Knox; Turner, 1892.)	Alloa, Scotland, 1888. Univ. of Edinburgh. (Turner, 1892.)	Elie, Scotland, 1879. Univ. of Edinburgh. (Turner, 1892.)	Burntisland, Scotland, 1870. Do. Do.	Dunbar, Scotland, 1871. Do. Do.	Granton, Scotland, 1888. Do. Do.	Bergen, Norway. Upsala Univ. Mus. (Liljeborg, 1862.)	Greenland. British Museum. (Gray, 1846.)	Harwichport, Mass. (20731, U. S. N. M.)	Loc. unknown, Cal. Acad. Sci. (Dall, 1874.)	St. Paul Id., Alaska. C. H. Townsend. (61715, U. S. N. M.)	Puget Sound, Wash. Type of *B. davidsoni*. (12177, U. S. N. M.)	Coast of Norway. (13977, U. S. N. M.)
Sex and age	♀ jr.	jr.	♂ jr.	♀	♂?	♀ ad.			jr.		ad.[5]	♀ ad.[5]	ad.[5]
Total length of whale	9′ 11″		18′	18′	30′ ±	28′ 4″							
Total length of skeleton							23′0″[2]						
Length of skull (condylo-premaxillary, straight)	32″	40″	44½″[1]	46″[1]	71½″[1]	70″	62½″[2]	49″[3]	43½″	48″	61.25[1]	61.5″	60.5″
	%	%	%	%	%	%	%	%	%	%	%	%	%
Length of beak	62.5	62.5	60.7	60.0	67.3	67.8	65.2	62.0[3]	61.5	62.5	62.0[1]	61.8	60.8
" " maxilla	67.2	69.4	68.0	70.1	72.7	73.2	.....	.....	70.1	68.7	.....	.....	.....
" " premaxilla	64.6	69.4	71.3[1]	72.8[1]	74.8[1]	75.7	.....	.....	71.9	.....	75.9[1]	73.6	75.2
From ant. border foramen mag. over vertex to tip of beak	.....	102.5	103.2[1]	103.2[1]	105.0[1]	106.4	.....	.....	104.6	.....	102.1[1]	104.1	104.1
Ditto to upper border of occiput	.....	28.1	28.1	28.3	26.2	27.1	.....	.....	29.3	.....	25.3	27.6	28.1
Greatest breadth of skull	50.0	.....	51.7	50.0	54.6	55.4	56.6	.....	51.1	.....	54.7	57.3	57.2
Breadth at base of beak	31.3	31.9	32.6	30.5	33.9	32.9	33.6	31.8	32.2	34.4[4]	32.7	35.0	33.9
" " middle of beak	21.9	25.6	22.5	21.8	23.1	24.3	21.2	20.4	19.8	18.8[4]	17.9	20.7	20.7
" " " " orbital borders of frontals	46.9	45.0	44.0	45.6	50.7	51.0	.....	44.9	44.3	.....	50.0	53.3	52.1
Greatest breadth of maxilla behind base of beak	45.3	...	41.6	.....	49.7	49.3	.....	.....	45.0	.....	48.2	.....	50.4
Greatest breadth between outer borders of both premaxillæ	9.4	11.9	11.8	10.9	13.3	13.6	.....	.....	11.3	.....	13.4	15.4	13.6
Greatest breadth between inner borders of both premaxillæ	7.8	10.0	10.1	8.7	10.5	10.0	.....	.....	9.9	.....	9.8	10.6	9.1
Height from vertex to pterygoids	.....	25.0	29.2	27.7	29.4	30.0	.....	.....	.....	.....	.....	.....	.....
Length of mandible (straight)	93.8	99.4	96.6	98.9	100.7	101.4	.....	.....	97.7	97.9	.....	.....	100.0
" " " along outer surface	98.4	103.7	103.4	106.5	108.0	109.3	105.0	.....	103.4	.....	.....	.....	109.0
Height of mandible at condyle	10.2	8.7	10.7	9.8	10.5	9.3	.....	.....	9.9	....	.....	.....	.....
" " " " coronoid	13.3	12.5	12.3	12.5	12.9	12.8	.....	.....	12.6	12.5	.....	.....	13.1
" " " " symphysis	5.5	5.6	5.1	4.3	5.6	5.4	.....	.....	5.7	.....	.....	.....	.....

It will be found by examination of the foregoing table that the dimensions of the Massachusetts skull shows a surprisingly close approximation to those of the Scotch skulls of the same size, amounting indeed to identity. The few points of disagreement are probably due to differences in the relative positions of the several bones of the skull arising from shrinkage in drying, etc. These are as follows: (1) A very slight excess in the length of the skull measured over the occipital bone,

[1] 2″ added for breakage.

[2] Swedish. In straight line.

[3] From *Zoöl. Erebus and Terror*, p. 50; 2.4″ added for premaxillæ. In *P. Z. S.*, 1864, p. 399, Flower mentions two skulls in R. Coll. Surg., as follows: Adolescent; length, 65″; breadth, 54%; breadth of beak at middle, 23%. The 2d is young. Length, 48″; breadth, 50%; breadth of beak at middle, 20%. Also an adolescent skull at Brussels. Length, 63″; breadth, 54%; breadth of beak at middle, 21%.

[4] Curved.

[5] The measurements of these three specimens were taken by me at the same time by the same method in straight lines, with calipers, and are strictly comparable.

amounting in actual measurement to about $\frac{6}{10}$ of an inch; (2) a slight excess in the height of the occiput, amounting to $\frac{4}{10}$ of an inch; (3) a decrease in the breadth of the beak at the middle. These can scarcely be regarded as having any considerable importance.

In comparing the young individuals of which Sir Wm. Turner has given measurements with the adult, it is interesting to observe that the beak increases decidedly in relative length in the latter, causing all the dimensions which include the beak to show an increased proportion to the total length. The same is true also of the width of the skull across the squamosals and the orbital plates of the frontals, and the length of the mandible. On account of these changes in proportions incident upon growth, it is necessary to compare skulls of the same age,—adults with adults, and immature specimens with immature specimens,—to arrive at correct conclusions.

For comparison of details of structure I have had the use of the skull from Norway in the U. S. National Museum (No. 13877), and such figures as are found in the literature. The Massachusetts skull and the Norwegian one are figured on pls. 22, 24, and 26. The former is from a much younger individual than the latter.

On comparing the figures it will be seen that in general the correspondence is very close, but that in a number of details the two skulls exhibit differences. For example, the nasals are longer and narrower in the American skull than in the Norwegian, the proximal ends of the nasal processes of the maxillæ are narrower, and the anterior margin of the supra-occipital is more rounded. To determine whether these and other minor differences are of importance, it is necessary, of course, to make further comparison with other skulls. This I am only able to do through the figures hitherto published by various cetologists.

So far as I am aware, no adequate figure of the skull of the European *B. acuto-rostrata* has been published hitherto. The drawings of the lateral surface and of one half the superior surface, reproduced by Capellini (*12*, pl. 1, fig. 1; pl. 2, fig. 1) are on the whole the most satisfactory. Eschricht's figures (*37*, pl. 9) are excellent, but appear to be out of proportion in the posterior part, especially as regards the tympanics and nasals. Extended descriptions have been published by Carte and Macalister (*14*), Capellini (*12*), and Van Beneden and Gervais (*8*).

The Massachusetts skull agrees very closely with Capellini's figures, as will be seen by comparison of plates 22, 24, and 26. The descriptions also appear to agree well, as far as I have been able to interpret them. In one particular, however, Carte and Macalister's account is not in accord. They state that the malar bone is broader behind than in front and that "its wider or posterior extremity was flattened and fitted in between the anterior border of the glenoid process of the squamous bone and the posterior angular process of the frontal, where a digital depression existed for the reception of the former" (*14*, 213). No such shape or articulation is to be found in the Massachusetts skull, in which the anterior end of the malar is the broader, and the posterior smaller end articulates, as would be expected, with the

temporal. In these two particulars it agrees with Capellini's figures, and one is led to infer that in the skull examined by Carte and Macalister the malar was reversed and out of its natural position. Eschricht's figures (*37*, pl. 9) agrees with Capellini's and with the Massachusetts skull. In the latter the lachrymal is wanting, but the malar has an anterior flat process which fits in between the maxillary and frontal, and may be supposed to represent the lachrymal, which has become fused with the malar. (See plate 26, fig. 2.)

In the details mentioned above,—the shape of the nasals, maxillæ, etc.—Capellini's figure agrees rather with the American skull than with the Norwegian, while Eschricht's figure corresponds most closely with the latter. It should be remembered that the Massachusetts skull and that figured by Capellini are from young individuals, while the Norwegian skull in the National Museum and that figured by Eschricht are from adults. It is probable that some of the differences observable are due to age.

On the whole, there is nothing tangible on which to base a distinction between the American and European specimens, while in proportions, as shown by Sir Wm. Turner's measurements, there is the closest agreement, amounting to identity. A separation of American and European specimens on the basis of cranial characters does not, therefore, seem warranted.

SKELETON.

Of the descriptions of the skeleton of the European *B. acuto-rostrata* given by Van Beneden and Gervais, Van Bambeke, Carte and Macalister, and other writers, two, three, or all agree in assigning to *B. acuto-rostrata* the following characters: Neural spine of the atlas very short or rudimentary; spine of the axis larger, and its parapophyses and diapophyses united to form a bony ring; diapophyses of the 7th cervical next in size to those of the axis, and followed by those of the 6th cervical; neural spines of the 3d to the 5th cervicals rudimentary; parapophysis of the 7th cervical reduced to a tubercle; diapophyses of the 3d to the 5th cervicals directed backward, those of the 6th and 7th cervicals forward; centra of the lumbars increase in length from the beginning to the end of the series; inferior process on last lumbar strong; lumbar neural spines at the maximum as regards size; lumbar diapophyses equal to those of the last dorsal; caudal centra not longer than those of the lumbars; last caudal diapophysis and neural spine on the 36th vertebra; neural spine replaced by a trough on the 39th vertebra; first vertebra with perforated diapophysis, the 35th; chevrons, nine, decreasing in length from 2d to 9th, the 1st small, 1½ times the length of the second, the 2d longest, and the 3d broadest antero-posteriorly; ribs increasing in length from 1st to 4th, the first shortest and widest; scapula with the acromion recurved.

The skeleton from the coast of Massachusetts, No. 20931 (plate 27, fig. 2), presents the majority of these characters, but shows the following slight variations: The diapophyses of the 3d to 5th cervicals are transverse rather than directed backward. The 4th, 5th, and 6th pairs of ribs are of the same length (26 inches in a straight line) and are the longest of the series.

The description of Van Beneden and Gervais in the Ostéographie (*8*, 157) is not taken into consideration in the foregoing analysis as it is based chiefly on a specimen from Greenland, which in the present work is not regarded as necessarily identical with *B. acuto-rostrata*, but as the description tallies very closely with that of European specimens, it lends strength to the conclusion that the Greenland form is not distinct.

The following notes on the cervical vertebræ and other bones of the Massachusetts skeleton (20931, U. S. N. M.) will be of interest:

The spine of the axis is very thick at the base and divided or almost bifurcated in front; posteriorly, projecting out over the top of 3d cervical, to which it is anchylosed on the left side. The real spine of the axis is a thin ridge about 2 in. long.

The diapophyses of the 3d to the 6th cervicals are almost equal in development, transverse, and slender; shorter than in the axis or in the 7th cervical. That on the right side of the 3d cervical is shortest, but that on the left side is longer than in the 4th cervical.

The diapophysis of the 7th cervical is much longer and thicker and inclines strongly forward and also downward below the plane of the end of the parapophysis of the 6th cervical.

The parapophyses of the 3d and 4th cervicals are short and thick, especially distally, and nearly transverse, but strongly inclined downward. Those of the 5th and 6th cervicals are much longer and thinner, and are strongly bent upward and forward. The parapophysis of the 7th cervical is a mere tubercle.

The neural arch of the 3d cervical is open above and anchylosed to the spine of the axis on the left side, as already stated. The spines of the 4th and 5th cervicals are mere rudiments; of the 6th, about a $\frac{1}{2}$ in. long; and of the 7th, about one inch long, conical and equal to the spine of the 1st dorsal.

The last caudal vertebra is about as large as a pea. It seems probable that one is missing between it and the next one anteriorly, which is much larger, but such may not be the case.

The 4th, 5th, and 6th ribs are of the same length (26 in., straight) and are the longest of the series.

As regards the number of vertebræ, the various records are not entirely in accord, but such variation as there is rather accentuates the general agreement than otherwise. The enumeration of Sir Wm. Turner (*92*, 63) is probably the most accurate, having been made under favorable circumstances, and with the intent of correcting previous errors. The majority of museum specimens, however, are not absolutely perfect as regards the final caudal vertebræ. The majority of European specimens have been found to have 48 vertebræ, including 12 lumbars. This is the number in the Massachusetts skeleton also, which may, however, possibly lack the penultimate caudal. The variations recorded by different observers are as follows:

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN. VERTEBRAL FORMULA.

Locality.	Sex and Age.	C.	D.	L.	Ca.	Total.	Authority.
Norway	....	7	11	12	18	48	Eschricht.[1]
(Normal)	....	7	11	13	17	48	Van Beneden.
(Bergen Mus.)	....	....	....	....	.....	49	Van Beneden.
(" ")	....	....	....	....	.....	46	Van Beneden.
Dogger Bank	....	7	11	12	18	48	Flower.
North Cape	....	....	....	....	.... .	47	Van Beneden.
(Cambridge Mus.)	....	....	....	....	.....	47	Van Beneden.
(Brussels Mus.)	....	7	11	12	17 +	47 +	Flower.
Cherbourg, France	....	....	....	....	.....	46 (+ ?)	Lacépède.
Greenland	....	7	11	12	.....	.....	Flower.
Queensferry, Scotland	....	7	11	12	19	49	(Knox). Corrected by Turner.
(Breslau Mus.)	....	....	....	....	.....	48	Barkow. " " "
Granton, Scotland	♀	7	11	13	19	50	Turner, 1892. (Especially accurate.)
Drogheda, Ireland	♀	7	11	13	15 +	46 +	Carte and Macalister.
Cromer, England	♂	7	11	12	20	49	Flower.
Coast of Norway	...	7	11	12	18	48	Malm.
Bergen, Norway	♂ jr.	7	11	12	18	48	Malm.
" "	jr.	7	11	13	15 (+ 1 or 2)	46 (+ 1 or 2)	Malm.
Vergeroux, France	♂	7	11	13	16	47	Fischer.
Bergen, (Paris Mus.)	....	7	11	12	18	48	Fischer.
Mass. (20931, U. S. N. M.)	....	7	11	12	18	48[2]	F. W. T.

The agreement as regards number of dorsal vertebræ shown in the foregoing table is quite remarkable, and is in contrast with the variation found in other species of *Balænoptera*, and among the Cetacea generally. It will be seen also that the lumbars show a variation of but one. The variation in number of caudals, exclusive of that due to defects, probably does not exceed two. Eschricht remarks as follows regarding the vertebral formula of the Norwegian *Vaagehval* (*36*, 322):

"In all the fœtuses of the *Vaagehval* examined by me, I found, 48 vertebræ, of which 7 were cervicals, 11 dorsals, 12 lumbars, and 18 caudals; furthermore, this was exactly the number of vertebræ in the whole spine and in each of its different sections, not only in the complete *Vaagehval* skeleton from Bergen examined by me and the specimen examined in Christiania in 1844 (p. 304) as well as that sent from the west coast of Jylland in 1841 (*Videns. Sels. Skr.*, 11, p. 175), but also in the three small finback skeletons sent down from Greenland. Likewise, according to both Governor Christie's written communication regarding those Bergen *Vaagehval* skeletons which did not come under my observations, and Dr. Kröyer's statements relative to the skeletons of *Vaagehvals* preserved in the Bergen Museum (*Naturh. Tidskr.*, 2, p. 634), this numerical proportion may be considered constant in the species."

CHEVRONS.

The number of chevrons in European specimens is usually nine, but sometimes eight. The number in the Massachusetts specimen is nine.

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN. NUMBER OF CHEVRONS.

Locality.	Number.	Authority.
Drogheda, Ireland	8	Carte and Macalister.
Bergen, Norway	8	Malm.
" "	9	"
Coast of Norway	9	"
Cromer, England	9	Flower.
Granton, Scotland	9	Turner.
Harwichport, Mass., No. 20931	9	F. W. T.

[1] "In all the fœtuses of the *Vaagehval* examined by me, I found 48 vertebræ."—ESCHRICHT.

[2] Should probably add one for penultimate caudal.

For a comparison of the proportions of the vertebræ there are unfortunately no data of importance. The European skeletons of which measurements are available are all adult, while the Massachusetts skeleton is quite young. I have, however, assembled a number of measurements in the following table, both of the vertebræ and of other parts of the skeleton:

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN. SKELETON.

	Granton, Scotland. Edinburgh University. (Turner, 1892.)	Cromer, England. 1860. (Flower, 1864.)	Bergen, Norway. Upsala Univ. Museum. (Lilljeborg, 1862.)	Norway. 13877, U. S. N. M.	Norway. Carol. Inst., Stockholm. (Malm, 1869.)	Drogheda, Ireland. 1863. (Carte and Macalister, 1867.)	Harwichport, Mass. 20931, U. S. N. M.
Sex and age	♀ ad.	♂ ad.	.....	ad.	jr.	♀ jr.	jr.
Total length of whale	28′ 4″	.....	.....	.....	.....	13′ 11″	.....
" " " skeleton		24′ 4″	23′ 0″ [1]	.....	17′ 7″	.....	16′ 5½″
Length of skull, straight	70″ [1]	65″ [3]	62.5″ [4]	60.5″	48.8″	37″	43.5″
	%	%	%	%	%	%	%
Greatest breadth, axis	28.9 [2]	26.2 [2]	26.8 [2]	26.8 [5]	.....	20.9 [9]	24.7
Depth centrum, "	.....	.....	.....	5.3 [8]	.....	.....	6.3
Greatest breadth, 1st dorsal	.....	.....	.....	26.4	.....	.....	22.4
Depth centrum, " "	5.4	.....	.....	5.8 [7]	.....	.....	6.3
Greatest breadth, 1st lumbar	.....	.....	.....	41.4	.....	39.2	37.0
Depth centrum, " "	.....	.....	.....	7.5	.....	.....	7.5
Greatest breadth, 1st caudal	24.3	.....	.....	28.2	.....	.....	25.3
Depth centrum, " "	10.0	.....	.....	9.5 [7]	.....	.....	8.7
Greatest length sternum	27.9	22.3	22.8	24.0	.....	.....	14.4
" breadth "	12.9	15.4	15.2	12.8	.....	.....	10.3
" " scapula	42.9	40.8	37.6	39.8	.....	31.8	33.9
" depth, "	22.9	23.1	22.4	22.8	.....	20.3	20.7
Length of radius	26.4	24.6	27.2	24.9 [8]	22.9	23.0	25.3
" " ulna	25.7 ±	.....	24.4	21.9 [8]	.....	19.6	23.6

In the foregoing table it will be seen that on account of difference of age only Carte and Macalister's specimen is comparable with the Massachusetts skeleton. Of the former, the measurements which can be used are, unfortunately, very few, and these few do not all show agreement. The most notable discrepancy is in the length of the radius and ulna. Carte and Macalister do not explain whether the

[1] Condylo-premaxillary.
[2] Atlas = 19.2 %.
[3] To condyles.
[4] Swedish measure. In straight line.
[5] Atlas = 18.7 %.
[6] Posterior median.
[7] Anterior.
[8] With proximal epiphysis.
[9] Atlas.

epiphyses were included in the measurement, and the importance of the difference cannot, therefore, be determined. Capellini's figure and measurements (which are not precisely stated) appear to show that the length of the radius, with the epiphysis, was between 21.4 % and 21.8 % of the length of the skull in that specimen.

SCAPULA.

The scapula of *B. acuto-rostrata* is not especially characteristic. It presents almost the same outlines as those of the scapula of *B. musculus* (L.), though of course it is much smaller. The posterior portion of the superior margin is somewhat more sharply bent downward than in *B. musculus*, and the acromion is long and somewhat recurved at the tip. Carte and Macalister's specimen from Drogheda, Ireland, is the only one young enough for comparison with the Massachusetts skeleton. In the former the breadth of the scapula is 31.8 % the length of the skull, and its depth 20.3 %, while in the latter the breadth is 33.9 % and the depth 20.7 %.

FIG. 53.

FIG. 54.

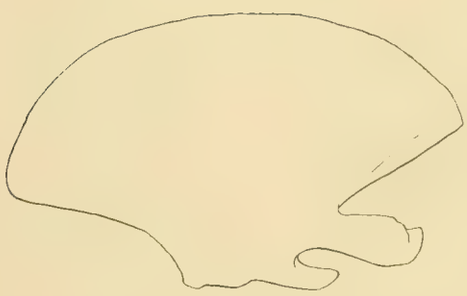


FIG. 55.

FIG. 56.

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN. SCAPULA.

FIG. 53.—NORWAY. AD. (FROM ESCHRICHT.) FIG. 54.—HARWICHPORT, MASS. IM. (FROM A PHOTO.) FIG. 55.—NORWAY. AD. (FROM A PHOTO.) FIG. 56.—NORWAY. (FROM VAN BENEDEN AND GERVAIS.)

If the various specimens in the foregoing table (p. 202) are arranged according to the length of the skull, it will be seen that the percentage of the breadth of the scapula rises as the size of the skull increases. This is, of course, to be expected, but it prevents direct comparison of young with adult specimens. The percentages are as follows:

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN. SCAPULA.

Locality.	Length of Skull in Inches.	Percentage of Breadth of Scapula.	Percentage of Depth of Scapula.
Drogheda, Ireland.....	37.0	31.8	20.3
Mass. (U. S. N. M.).....	43.5	33.9	20.7
Norway (U. S. N. M.)...	60.5	39.8	22.8
"	62.5	37.6	22.4
Cromer, England.....	65.0	40.8	23.1
Granton, Scotland.....	70.0	42.9	22.9

The Norwegian skeleton in the National Museum is the only one which breaks the regular gradation.

The scapula of *B. acuto-rostrata* appears to have been seldom figured. Eschricht's figure, copied above, is not very satisfactory, and the figure in the Ostéographie appears distorted. Outlines of these figures and of the scapulæ of the Massachusetts and Norway specimens in the National Museum are shown in text figs. 53 to 56. The scapulæ of the last two are also figured on pl. 27, figs. 3 and 4.

In respect of number of phalanges the skeletons preserved in museums are usually defective, and no accurate comparisons can be made. The numbers derived from examination of fœtal specimens are far more satisfactory, but the two series are, of course, hardly comparable. The enumerations of various cetologists for *B. acuto-rostrata* are as follows:

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN. PHALANGES.

Locality.	Age.	Phalanges.				Authority.
		II.	III.	IV.	V.	
Bergen, Norway.....	Ad.	4	7	6	3	Lilljeborg
" "	.....	3	7	6	3	"
" "	.....	4	6	5	3	Fischer
" "	Jr.	5	8	7	4	Malm
" "	"	4 (+ 1)	8	7	1 (+ ?)	"
.....	Embryo	4	9	8	4	Kükenthal
.....	"	4	9	7 (8)	4	"
.....	.....	3	7	6	3	Eschricht
.....	.....	3 (4)	7	6	3	Weber

For the skeleton from the coast of Massachusetts, No. 20931, which is that of a young animal, the formula is as follows: Left, 3. 6. 6. 0 +.; right, 2 +. 7. 5 (+1). 1+.

STERNUM.

The sternum of the Massachusetts skeleton has not at all the Latin-cross form characteristic of adult specimens of *B. acuto-rostrata*, but it represents, doubtless, an immature stage leading up to that form. The anterior moiety is short and broad, with a rounded contour; on each side is a tubercle, or rudimentary arm;

and behind is a narrow, and rather irregularly cylindrical prolongation. (See pl. 27, fig. 6 and text fig. 63.)

Bambeke figures a quite similar sternum belonging to the skeleton in the Museum at Gand, which he describes as shaped like "a nail, with a conical head" (*1*, 61). Carte and Macalister's figure of the sternum of the Drogheda, Ireland,

FIG. 57.

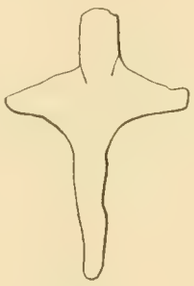


FIG. 58.

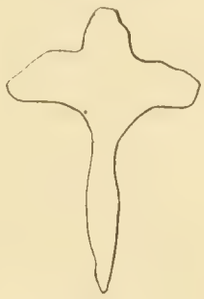


FIG. 59.

FIG. 60.

FIG. 61.

FIG. 62.

FIG. 63.

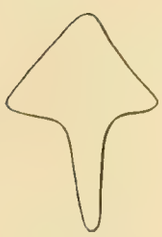


FIG. 64.

FIG. 65.

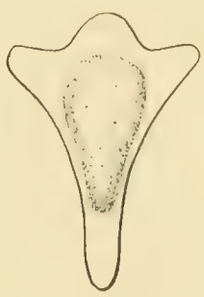


FIG. 66.

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN. STERNUM.

FIG. 57.—NORWAY. AD. (FROM GERVAIS.) FIG. 58.—CROMER, ENG. AD. ♂. (FROM FLOWER.) FIG. 59.—BOULOGNE, FRANCE. AD.? (FROM FISCHER.) FIG. 60.—NORWAY. AD. (FROM PHOTO.) FIG. 61.—NORWAY? (FROM ESCHRICHT.) FIG. 62.—GREENLAND. IM.? (FROM ESCHRICHT.) FIG. 63.—HARWICHPORT, MASS. IM. (FROM A PHOTO.) FIG. 64.—BELGIUM. JR. (FROM VAN BAMBEKE.) FIG. 65.—DROGHEDA, IRELAND. JR. ♀. (FROM CARTE AND MACALISTER.) FIG. 66.—BRETAGNE, FRANCE. JR. (FROM GRATIOLET.)

specimen (*14*, pl. 6, fig. 1) shows it to be elongated heart-shape, with a posterior prolongation. This form is totally unlike that of any other specimen of the species hitherto figured, except the Bretagne specimen cited by Fischer (*44*, 87, pl. 3, fig. 1). In the latter the sternum consists of an oblong ossified central portion surrounded by a somewhat cruciform cartilaginous portion. The osseous part bears a resemblance to the sternum of the Drogheda specimen. (See text figs. 57–66.)

As the sternum is to be regarded partially in the light of a rudimentary organ, it is not surprising that it varies widely, like all other rudimentary parts. In adults, however, the variation appears to be less than in other species of *Balænoptera*. Little stress can be laid upon the form of the sternum of the Massachusetts specimen from a systematic point of view, as there are no other American specimens with which to compare it, and it is not from an adult.

The scale of Eschricht's figures, copied above, appears to have been incorrectly given by him.

As I remarked at the beginning of this chapter, the American material at command is so meagre as to be unsatisfactory for the solution of the questions at issue. Nevertheless, I think the remarkable correspondence between the careful measurements of Sir Wm. Turner on the Scotch skulls, and my measurements of the skull from the coast of Massachusetts, is a sufficient proof of the identity of the latter specimen with *B. acuto-rostrata*. It is my opinion that the lack of correspondence in other particulars between the American specimens and those from European waters is due partly to inaccuracies in descriptions, measurements, and drawings, and partly to age and individual variation.

Regarding the identity of Greenland specimens with those from the United States, I am unable to offer any new proof, not having had any material from the former locality. The opinions of those who have compared Greenland and European specimens in the various European museums are cited below.

OPINIONS OF EUROPEAN CETOLOGISTS REGARDING EUROPEAN AND AMERICAN SPECIMENS OF *B. ACUTO-ROSTRATA*.

Lacépède (1803–4) treats Fabricius's Greenland *B. rostrata* and Hunter's North Sea specimen as one and the same species, but without critical remarks. It was not long afterward that the species itself all but dropped from view on account of Cuvier's destructive criticism of the species of Finback whales.

In 1840 and the years immediately succeeding, Eschricht received three skeletons of immature females of the small whalebone whale of Greenland (the first of their kind to arrive in Europe), and as he already had a skeleton of a *Vaagehval* from the coast of Norway, he was in a position to institute comparisons of value. He appears at first to have regarded the Greenland species as distinct, but in his Untersuchungen (1849) he withdraws this opinion in favor of the view that it is the same as the European *acuto-rostrata*, specifically if not subspecifically. He remarks: "In consequence of the new light on the subject, I must, at all events, confine myself to the view that the Greenland and Norwegian dwarf-whales appear to show the same subordinate mutual variations which are found in many species of land-animals in their varied geographical distribution" (p. 174).

This remark leads the way to considerations of the most fundamental importance from a taxonomic point of view. Many such minor geographical variations as those alluded to by Eschricht are at this day commonly recognized as species and subspecies. That they exist among whales as among land animals is

very probable, but on account of the great amount of individual variation among cetaceans it would be an almost hopeless task to recognize and characterize them without a wealth of material which no museum in the world possesses to-day. To bring together a hundred or a thousand specimens of mice or sparrows side by side for comparison is an easy task, but to accomplish the same for the huge whalebone whales is almost beyond the bounds of possibility. To say nothing of mechanical difficulties, the expense involved would be prohibitive.

The most that the cetologist can hope to do is by collating notes upon, and measurements, photographs, and drawings of, such specimens as can be found at the whaling stations and in museums, to detect constant differences of considerable magnitude. These differences will form the basis of his species. Beyond this he can scarcely go, with any feeling of certainty.

The importance of the bearing of these considerations on the questions of geographical distribution cannot be ignored, and it may be thought that they impair the usefulness of the present inquiry, for it is a well-known fact that among migratory species groups of individuals presenting but slight differences may follow quite different routes of migration and occupy quite widely separated stations.

There is no doubt much force in criticism along this line, and it should put the cetologist on his guard against relying too implicitly upon the results of the rather crude methods which alone are open to him in systematic work. Nevertheless, conclusions as to geographical distribution based on such results, carefully worked out, must certainly have more value than opinions formed on *a priori* grounds, without actual examination of specimens, of which cetology has not been free in times past. Furthermore, examination of even a small number of specimens may lead to the detection of large differences, and so put the question of close relationship out of court.

The differences between the Greenland and Norwegian skeletons of *B. acutorostrata* which Eschricht finally thought might be of importance were as follows: (1) A slight difference in the position of the dorsal fin, amounting to $\frac{1}{48}$ the total length, as shown in a sketch received by him; (2) union of the lateral processes of the 5th and 6th cervical vertebræ in the immature skeletons from Greenland, a condition not found by him in Norwegian specimens of more advanced age; (3) the coronoid process of the mandible "higher, smaller, and more strongly bent outward" in the Greenland skeletons; and (4) absence of obliquity of the upper jaw in the latter.

As to the first point, the position of the dorsal fin, it may be said that a variation of $\frac{1}{48}$ of the total length, amounting actually in the case of the Greenland specimen to about 4 inches, is not greater than is found in other species of *Balænoptera*. In this particular case, however, it is quite as likely that the sketch was slightly inaccurate, as that the variation actually existed. At all events, no stress can be laid on this point under the circumstances.

The second point brought forward by Eschricht as possibly serving to distinguish the Greenland species was that the specimens though immature and only about 17 or 18 feet long, had the processes of the 5th and 6th cervicals united,

forming complete bony rings, a condition not found in the Norwegian *Vaagehval.* Van Beneden (*8*, 161) brought together some facts tending to show that this was not a matter of importance from a systematic point of view. His observations on the condition of the lateral processes of the cervicals in various specimens, with those quoted from Eschricht, Flower, and Gray, are as follows:

BALÆNOPTERA ACUTO-ROSTRATA LAC. GREENLAND AND EUROPE. CERVICAL VERTEBRÆ.

Vertebra.	Greenland. Louvain Museum.		Greenland. British Museum. Skull, 46.6 in. long.		Greenland. Copenhagen Mus. Length, 17–18 ft.		Norway. Leiden Museum. Adolescent.		Cromer, England. Mus. Coll. Surgeons. Length, 25 ft.		Yarmouth, England. Length, 18 ft. ♀	
	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.
Axis	×	×	×	×	? ×	? ×	×	×	—	—	×	×
3d cervical	—	—	—	—	—	—	—	—	—	—	—	—
4th cervical	—	—	—	—	—	—	—	—	—	—	—	—
5th cervical	—	—	—	—	×	×	—	—	—	—	—	—
6th cervical	—	—	—	—	×	×	×	×	—	×	—	—
7th cervical	—	—	—	—	—	—	—	—	—	—	—	—

× = Complete ring formed by union of lateral processes.
L. = Left side.
R. = Right side.

Perhaps the most important of these specimens is the one in the British Museum. The skull of this, according to Gray, was 46.6 in. long, hence the whole animal was probably not far from 18 feet, the length of Eschricht's specimens. Yet only the axis had complete osseous rings. The same was the case with the Greenland specimen in the Louvain Museum, but the size of this is not given by Van Beneden.

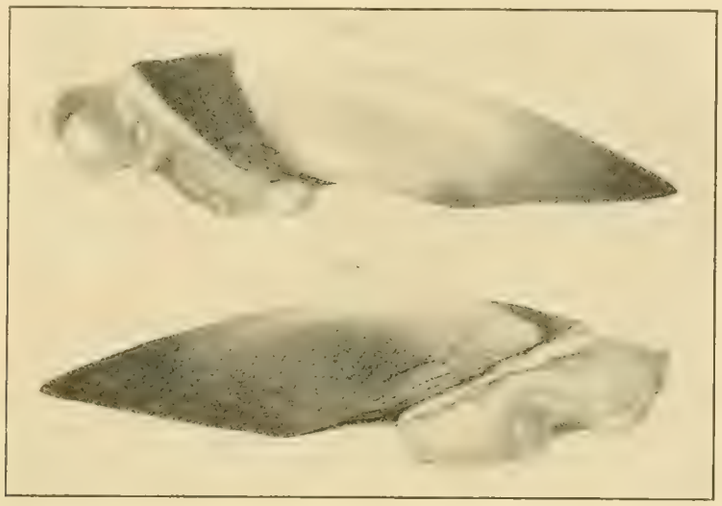
As Eschricht did not figure the coronoid process of his Greenland specimens, it is impossible to estimate the importance of the character drawn from its shape and size. Fortunately, Gray's figure of the skull of the Greenland form, in his Zoölogy of the Voyage of the *Erebus* and *Terror*, shows this part.[1] I am unable to see that it presents any characters of importance. It is about as high as in Norwegian specimens.

The same is true as regards the lateral distortion of the maxillæ. This does not appear to be more or less in the Greenland skull than in Norwegian skulls.

The characters mentioned by Eschricht, taken as a whole, do not therefore appear of special importance. If the small Greenland Finback is to be distinguished it must be by means of other peculiarities. Eschricht himself mentions one several times, but does not appear to regard it as of any importance as a diagnostic charac-

[1] Pl. 2, p. 50.

ter. This is the color of the pectoral fin. In his figure of the lower side of a pectoral fin of the Greenland form (*37*, pl. 8, fig. 2), which was sent to him in salt in perfect condition, the black color is seen to occupy all but a small portion near the root, while in Bocourt's figure of the Bretagne specimen and other European specimens the broad white band is nearly as well marked on the lower side of the pectoral as on the upper. A copy of Eschricht's figure is here given, text fig. 67. Of



BALÆNOPTERA ACUTO-ROSTRATA LAC. GREENLAND. PECTORAL FIN.

FIG. 67.—(1) ANTERIOR OR OUTER SURFACE. (2) POSTERIOR OR INNER SURFACE. (FROM ESCHRICHT.)

the Greenland pectoral, Eschricht remarks: "Undeniably the black color has on the side named [the under side] a wider distribution than appears to take place in the *Vaagehval*" (*36*, 347). This may of course be merely an individual variation, but it is at least a very striking difference.

The Greenland skull figured by Gray agrees well in proportions, as already stated, with European skulls of equal size. If Gray's figure is correct, however, it presents some peculiarities of its own. The most striking of these is the shape of the premaxillæ which have considerably curved outer margins, and decrease in width gradually toward the proximal end, so that the nasal concavity is more elongated than in *B. acuto-rostrata*. The premaxillæ are also much more closely approximated in the median line than in the latter species. This and the other characters mentioned may be due to defects in the drawing, but as the figures in the Zoölogy of the Voyage of the *Erebus* and *Terror* are quite accurate, they are worthy of further attention.

Gray, who had access to the skeleton from Greenland in the British Museum, and who, as is well known, multiplied species without stint, remarks of this species: "Our Greenland skull does not appear to differ from that of the English skeleton" (*53*, 192). He combines American and European references in the same synonymy, and cites New York, Greenland, and Norway among the localities for the single species, "*B. rostrata*" (*53*, 188).

Van Beneden and Gervais follow the same course in the Ostéographie, adding Alaska to the list of American localities on the authority of Chamisso. They notice the form from Greenland which Holböll proposed to call *microcephala*, on account of its relatively small head, and remark: "As many skeletons are now known from these parts (Greenland), and since thus far no one has found any differences between them, there is every reason to suppose that in these *Balænopteræ*, as in *Balæna mysticetus*, there are individuals with smaller heads" (*8*, 152).

Van Beneden, in 1889, again expresses the opinion that the Greenland and European specimens are of the same species, and includes also Scammon's *B. davidsoni*, from the North Pacific.

CHAPTER VII.

THE HUMPBACK, *MEGAPTERA NODOSA* (BONNATERRE).

That a species of whale with very long pectoral limbs and with abdominal ridges, or, in other words, a Humpback, occurred in European waters, was not recognized by science until 1829, when Rudolphi read a paper before the Berlin Academy of Sciences in which he described a specimen stranded in November, 1824, at Vogelsand, at the mouth of the Elbe River (*76*). For this specimen Rudolphi proposed the name *Balæna longimana*.[1] He was content to leave the species in the Linnean genus *Balæna*, and it was not until 1845 that the Humpbacks were regarded as constituting a separate group. In that year Brandt established for them the subgenus *Boöps*, distinguished by the single character — "pectoral elongate."[2] This name is preoccupied by *Boöps* Cuvier, 1817 (fishes). In 1846 Gray renamed the genus *Megaptera*[3] and enumerated its principal characters (*56*, 16).

In Eschricht's list of whales stranded on the European coasts (*37*, 176) only two specimens are recorded between 1824 and 1846, a period of twenty-two years. Van Beneden (*7*) records very few others up to 1889. This is somewhat remarkable, as Cocks's statistics of the Finmark whaling stations show a considerable number of Humpbacks captured, aggregating from 40 to 100 annually.

Although the European Humpback was unknown to science until 1824, American species were described at a much earlier date and were introduced into zoölogical nomenclature by Fabricius under the name of *Balæna boöps* in 1780,[4] and by Bonnaterre under the name *Balæna nodosa* in 1789. Bonnaterre's species was founded on Dudley's description of the Humpback whale of New England waters. Fabricius's species was based on his own observations in Greenland.

In this case, as the American species (or one of them, if there are several) was named first, the question to be considered is whether the European species is to be regarded as a synonym. With the Finback whales the case is the reverse, the European species having been named first.

The fullest information regarding the European Humpback is to be found in

[1] Van Beneden (*7*, 121) mentions one having been stranded near Greifswald, March, 1545, another on the coast of Courland in May, 1578, and a third near Stettin in 1628. I have not found the sources from which Van Beneden derived knowledge of these specimens.

[2] BRANDT in Tchihatcheff's Voyage Sci. dans l'Altai Oriental. Paris, 1845. 4°.

[3] *Annals and Mag. Nat. Hist.*, 17, Feb., 1846, p. 83.

[4] Preoccupied by *Balæna boöps* Linnæus, 1758.

Struthers's elaborate monograph, published in 1889 (*87*) in Sars's Fortsatte Bidrag, 1881 (*80*), where there is an excellent figure of the exterior, in Cocks's accounts of the Finmark fisheries (*15–19*), and in Van Beneden's works.

For the Greenland species we have Fabricius's description (*41*, 36) and the extended discussion in Eschricht's Untersuchungen ueber nordischen Wallthiere, 1849 (*37*), and Van Beneden's comments on specimens distributed among various European museums by Eschricht.

Specimens from the Atlantic coasts of the United States and southward are not common. There are two skeletons in the National Museum, one in the Philadelphia Academy of Sciences (type of *M. bellicosa*, incomplete), one at Niagara, N. Y. (type of *M. osphyia*), one in the Public Museum, Milwaukee, Wis. All these I have seen and examined. I also examined three fresh specimens at the Snook's Arm whaling station, Newfoundland, in 1899.

SIZE.

The most satisfactory data relating to the size of the European Humpback are the measurements obtained by Cocks from the whales at the Finmark whaling stations in 1885 and 1886 (*17* and *18*). These measurements are chiefly in Norwegian feet, without inches, and are probably taken around the curves. They are more likely to overstate than understate the actual length. To compare with these, the measurements made by the whalers at Balena Station, Newfoundland, in 1900 and 1901, will be given. In addition, we have the measurements of various specimens stranded on the coasts of Europe and the United States at different times.

During my stay at the Snook's Arm Station, Newfoundland, in 1899, three Humpbacks were taken, having the following length from tip of snout to notch of flukes along the curve of the back:

MEGAPTERA NODOSA (BONNATERRE). SNOOK'S ARM, NEWFOUNDLAND. 1899.

Capture No.	Date.	Sex.	Total Length.
5	Aug. 9, 1899	♂	42 ft. 2 in.
6	" " "	♀	45 " 5 " [1]
21	" 18 "	♀	46 " 6 " [2]

The following specimens were taken at Balena Station, Newfoundland, in 1900 and 1901, and measured by the whalers. The measurement in each case is probably a maximum, along the curve of the back.

[1] Contained a male fœtus 3 ft. 3½ in. long.

[2] Contained a male fœtus 3 ft. 9 in. long.

MEGAPTERA NODOSA (BONNATERRE). BALENA STATION, NEWFOUNDLAND. 1900 AND 1901.

Date.	Sex.	Total Length.
1900		
April 26	♂	46 ft. 11 in.
May 7	♂	35 " 6 "
" "	♀	37 " 3 "
" 10	♂	38 "
" 12	♂	38 "
" 21	♀	34 "
" 22	♀	40 "
" 30	♂	36 "
June 7	♂	32 "
" 23	♂	37 "
July 6	♂	34 "
1901		
May 7	—	27 "
" 14	—	30 "
" 15	—	47 "
" 16	—	26 " "calf"
" 20	—	46 "
June 10	—	34 "
" 17	—	34 "

In order of size, the males and females of these, and the three Snook's Arm specimens, and the specimens not having the sex recorded, are as follows:

MEGAPTERA NODOSA (BONNATERRE). NEWFOUNDLAND.

Males.	Females.	Sex not Recorded.
46 ft. 11 in.	46 ft. 6 in.[1]	47 ft.
42 " 2 "	45 " 5 " [1]	46 "
38 " 0 "	40 " 0 "	34 "
38 " 0 "	34 " 0 "	34 "
37 " 3 "		30 "
37 " 0 "		27 "
36 " 0 "		26 "
35 " 6 "		
34 " 0 "		
32 " 0 "		
Maximum 46 ft. 11 in.	46 ft. 6 in.	47 ft. 0 in.
Minimum 32 " 0 "	34 " 0 "	26 " 0 "
Averages (10) 37 " 6 "	(4) 41 " 6 "	(7) 34 " 10 "

Cocks's statistics for the Finmark stations in 1885 and 1886 are as follows:

MEGAPTERA. NORWAY. 1885 AND 1886.

Males.	Females.
Maximum 53 ft. 0 in.	51 ft. 6 in.
Minimum 20 " 7 "	30 " 11 "
Average (25) 37 " 2 "	(6) 43 " 2 "

[1] Contained a male fœtus.

It appears that the maximum for Newfoundland specimens, whether males or females, is considerably less than for those taken at the Finmark fishery. The average is slightly larger for the Newfoundland males and considerably smaller for the females. As the figures include immature specimens these averages are of little value.

The male taken by Capt. Horn in 1886, and included in Cocks's statistics above given, is the largest North Atlantic Humpback of which there is a definite record. This was 53 ft. long, English measure. The largest female is that taken by Capt. Berg in 1885, which was 51½ ft., English, in a straight line. Cocks says of this specimen: "Capt. Berg told me that he had this season captured the biggest Humpback he has hitherto seen. It was a female, and measured 50 Norwegian feet (51½ feet, English) in a straight line (measured as Dr. Guldberg had directed)" (*17*, 6, sep.). None of the specimens which have stranded from time to time on the European or American coasts equal these two in length. Rawitz measured four Humpbacks at Bear Id. in 1899 (*74*, 75). The lengths, from the tip of the mandible to the notch of the flukes, were as follows: (1) ♀, 34 ft. 5 in. (10.5 m.); (2) ♂, 41 ft. (12.5 m.); (3) ♂, 41 ft. 8 in. (12.7 m.); (4) ♀, 46 ft. 9 in. (14.25 m.) The mandible extended 10 cm. beyond the upper jaw. Rawitz remarks casually that all four were sexually mature, but this cannot be accepted as correct. He mentions no fœtuses.

There are numerous general statements in literature according to the American Humpback much greater size than is above given. Many of these have been collected by Van Beneden (*7*, 111) and commented on at some length, and have also attracted the attention of Prof. Struthers (*87*, 4, foot-note). Van Beneden was inclined to credit the larger size, but Struthers appears sceptical.

The largest measurement is that given by an anonymous writer in the *Philosophical Transactions* for 1665 (Vol. i., No. 1, March 6, 1665, pp. 11 and 13; No. 8, Jan. 8, 166⅝, pp. 132–133), in an account of the whale fishery at the Bermudas. He states as follows: "Two old females and three cubs were taken at first and afterwards 16 other individuals. One old female was 88 ft. long, the flukes 23 ft. broad, the flipper 26 ft. long, the baleen 3 ft. long. The other female was about 60 ft. long, and of the cubs one was 33 ft. long, and the remaining two 25 or 26 ft." The great length of the flipper proves that the 88-ft. specimen was really a Humpback, and the proportion to the total length is nearly the same as in smaller European and American specimens.

In Hector St. John de Crèvecœur's Letters from an American Farmer, published in 1782, it is stated that the "Humpbacks on the coast of Newfoundland [are] from 40 to 70 feet in length." This general statement may, of course, be set aside as merely an opinion, or impression, but the measurements given in the case of the Bermuda Humpback cannot be so treated. Regarding this, Van Beneden makes the following excellent remarks (*7*, 110–111):

"There is without doubt a little exaggeration, but to judge by many bones that we have seen at Paris, Stockholm, and Bordeaux, the exaggeration is not great. . . .

"It appears at all events that in the European seas this animal attains this size but rarely, and if we see in the museums of Paris and Stockholm bones of extraordinary dimensions, we ought to believe that the sailors who have collected these pieces have chosen the bones which were the most remarkable on account of their size."

The 88-foot Humpback of 1665 must have been considered as presenting very extraordinary proportions, first, because measurements were made of the flippers, flukes, and whalebone, which was unusual at that time, and second, because the other "old female" is recorded as having a length of only 60 feet.

The Greenland Humpback, called *Keporkak* by the natives, was stated by Holböll to "reach a length of about 60 feet." (*37*, 196.)[1] This does not indicate a size much, if any, beyond that of the largest Norwegian specimens.

A much more satisfactory idea of the real size of these whales will be obtained by ascertaining the average size of adults. Unfortunately, this cannot be done by averaging the total length of skeletons in which the condition of the bones indicates full maturity, for very few such skeletons are known. The most that can be done will be to obtain an average of the length of specimens of females observed to contain fœtuses and hence at least sexually mature. No doubt the length may increase somewhat after sexual maturity is attained, but we shall have at least a convenient, and really significant minimum, and will be enabled to throw out specimens which are in every sense immature.

As already noted on p. 212, two females containing fœtuses captured at the Snook's Arm Station, Newfoundland, in 1899, were respectively 46 ft. 6 in. and 45 ft. 5 in. long. The average of these two is 45 ft. 11½ in.

Among the Finmark specimens recorded by Cocks is one female (with fœtus) of 45 feet, English, a length nearly equal to that of the Snook's Arm specimens. Cocks records three other females of greater length, and therefore entitled to be considered mature. The average length of the four specimens is 48 ft., a considerable increase over the average for the two Snook's Arm specimens, but still more nearly comparable with it than with the extraordinary dimensions already considered.

A female with young stranded between Fa and Karm Ids., Stavanger Amt, Norway, in 1846, and believed by Eschricht to have been a Humpback, measured 45 feet, Norwegian, or 46 ft. 4 in., English, a very close approximation to the Snook's Arm females.

The Finmark specimen described by Sars in 1881, which was a mature female (*80*, 8), was 14.2 m., or 46 ft. 7 in. (English), long in a straight line from tip of lower jaw to notch of flukes. The figure, measured along the curve of the back from the tip of the *upper* jaw to the notch, gives a length of 46 ft. 1 in., English. This is also very close to the larger of the Newfoundland specimens.

These and other data are brought together for comparison in the following table:

[1] Van Beneden interprets this statement incorrectly as follows: "Holböll va jusqu'a 60 pieds." (*7*, 111.) The original is "Der *Keporkak* erreicht eine Grosse von gegen 60'."

MEGAPTERA NODOSA (BONNATERRE). AMERICAN AND EUROPEAN. SIZE.

Locality.	Average for all specimens of both sexes.		Average for all females.		Average for all males.		Average for mature females.		Average for mature males.		Maximum[1] for females.	Maximum[1] for males.
	No.	Length.	No.	Length.	No.	Length.	No.	Length.	No.	Length.	Length.	Length.
NEWFOUNDLAND:												
Snook's Arm Sta., 1899...	3	44′ 8″	2	45′ 11½″	1	42′ 2″	2	45′ 11½″	..	.....	.....	.....
Balena Sta., 1900–1901...	18	36′ 2″	2	37′ 0″	9	36′ 11″	..	.....	1	46′ 11″	.....	.....
All the foregoing Newfoundland specimens	21	37′ 4″	4	41′ 6″	10	37′ 6″	2	45′ 11½″	1	46′ 11″	46′ 6″	46′ 11″[2]
Finmark Sta., (Cocks), 1885 and 1886	31	38′ 3½″	6	43′ 2″	25	37′ 2″	4	48′ 0″	3	58′ 11″	51′ 6″	53′ 0″
Europe generally (stranded or captured on the coasts)..	7	39′ 5″	2	38′ 11″	2	40′ 6″	1	46′ 10½″	..	.....	46′ 10½″	44′ 3″

It will be seen that the averages and maxima for the Norwegian specimens with one exception are larger than for the Newfoundland ones. Standing by itself this fact might be taken as an indication of specific distinctness. It will be remembered, however, that in both *Balænoptera physalus* and *B. musculus* the same relation prevailed, the Norwegian measurements exceeding the American. (See pp. 113 and 154.)

That this should happen in all three cases arouses the suspicion that the Norwegian measurements are taken differently and probably include the projection of the lower jaw beyond the upper and the breadth of the flukes. A larger number of specimens was included in every case, giving better opportunity for the introduction of one or two very large individuals, and thereby increasing the averages. In the case of the Humpback, the number of specimens is too small to be satisfactory.

An Iceland specimen, male, described by Hallas in 1868 (*60*, 176), was 43 feet, or 516 in. (Danish) long, from tip of upper jaw to notch of flukes.

COLOR.

Van Beneden's description of the color of the Humpback is as follows (*7*, 113): "The color of the animal is black; under the mandible in front it is entirely white, or mottled in the deep layers (*dans la profondeur*); between the ridges it is reddish. The caudal fin is black above, white below, surrounded by a black border; the margins are ordinarily scalloped. The pectoral fins are white on the two sides. The posterior part of the bosse (dorsal fin) is pure white."

This is far from being a satisfactory description, and is probably compiled from various sources, and may include the Greenland Humpback, or *Keporkak*.

Cocks gives the color of several Norwegian Humpbacks obtained in 1884 (*16*, 10 sep.). His notes, condensed, are as follows:

In three specimens the whole upper side of the body, both upper and lower parts of the head, and underside of body toward the tail, black. Otherwise varied, as follows:

[1] The minimums were as follows:

	Females.	Males.
Newfoundland	34′ 0″	32′ 0″
Finmark	30′ 11″	20′ 7″
Europe generally	31′ 0″	38′ 0″

[2] Also 1 specimen of 47 ft., sex undetermined.

(1) *Specimen about 40 ft. long.*—Throat, with its furrows, and nearly all of its under side, white; part of under side of flukes white; pectorals black above, white below, the black extending around the edge to the inner side, with an occasional blotch of black, and 2 or 3 black rings.

(2) *Specimen about 44 ft. long.*—Under side entirely black, except two white or marbled patches on the chest, just behind the flippers, and one or two very small white spots on belly; navel partly white; pectorals entirely white below, above with proximal quarter black, but black stopping short of anterior margin.

(3) *Specimen about 30 ft. long.*—Almost entirely black on the under side of body; pectorals white below, and only black above a little distance from proximal end.

Cocks gives additional notes on specimens captured in 1885, as follows (*17*, 4 sep.):

(1) *Male, about 35 ft. long.*—Entirely black on under side of the body except a not clearly-defined patch of white near each point of the under side of the flukes; some very small spots of white on chin and belly (due to barnacles). Pectorals all white below; above, black for a very short distance at the proximal end.

(2) *Specimen 44 ft. long.*—Pectorals above with the proximal quarter black, the black extending down the anterior edge, with a few small irregular black marks lower down.

(3) *Male, 42 ft. long.*—Entirely black on the belly, but nearly the whole chest and throat white; chin black, with a few small white flecks. Furrows on the belly light purplish flesh-color. A small white streak on the upper lip. Very little black on the outside of the pectorals, including a narrow rim along the hinder margin.

(4) *Small male.*—Chin black; some white on lower jaw; throat and chest white as far as posterior end of furrows; remainder of under side black.

Struthers's notes on the color of the Humpback obtained in the Tay River, Scotland, in 1883, give the following points (*87*): All black, except the snow-white under surface of the flukes and pectorals, and certain spots and streaks of white about the navel and genital orifice. (Color of the upper surface of the pectoral uncertain.)

Sars, describing the Finmark Humpback (*80*, 14), states that the color on the head and lower jaw is black, in the middle of the throat and breast, white, and elsewhere on the parts variegated white and black, with rings and spots. The back, sides, and the whole of the body behind the middle, black. Pectorals white on both sides throughout, sharply defined from the black color of the body, but with an ill-defined dark shading on the upper surface at the base. Flukes black above and below, with white rings along the posterior border, on both surfaces, but more numerous below.

Rawitz furnishes the following data relative to the color of the four Humpbacks examined by him at Bear Id. in 1899 (*74*, 74):

Male; length, 12.7 m.—Back and sides black. Tip of mandible black, with lighter places only here and there about its base. The knot-like projection on the throat also black, but with linear transverse white flecks anteriorly. From the projection to the line of the corner of the mouth the color is almost entirely white, stretching only half as far back on the left side as on the right. Middle of throat

dark gray, irregularly varied with white. The black of the sides extends further toward the median line of the throat on the left side than on the right. Breast white, irregularly varied with dark gray, the latter color growing less posteriorly. Pectorals entirely white on both sides. Flukes variegated above, the black predominating; below white with some black flecks, the free border black.

Female; length, 14.25 m.—Back and sides black. Chin, from tip to the knot-like projection, black, a little variegated on the sides with small white flecks. Posterior to the projection, the throat and breast pure white, with a black median streak, broad in front and narrowing rapidly posteriorly and ending about on line of the *manubrium sterni*, with a few black flecks extending posteriorly. Some black spots on the white of the under jaw. All the remainder of the throat, the whole breast and a part of the belly and tail, white. From the axilla and shoulder the black extends backward and goes into the furrows, while the ridges (*Wälle*) remain white. The black shows itself in all the furrows back of the navel. The black of the sides extends downward with a convex border in front of the genital region, then recedes again opposite the latter, and finally stretches "a short distance along the ventral side of the tail." The black does not reach the middle of the belly. The white posterior to the navel is overspread with black flecks, as if sprinkled from a brush. Pectorals white on both sides, with irregular black flecks only on the larger protuberances. Flukes white on both sides, with some black flecks only on the free border. White rings, produced by barnacles, on the snout, mandible, belly, pectorals and flukes, in both this and the preceding specimen.

Female; length, 10.5 m.—The whole ventral surface of the body without a trace of white flecks, but everywhere black. Pectorals black above, pure white below. Flukes black above, white below, with a variegated free border.

Male; length, 12.5 m.—Body black, slightly variegated in the furrows. Pectorals white on both sides. Flukes white below, variegated above and on the free margin.

These and other reliable observations show (1) that the European Humpback is normally black on the head, back, sides, and around the caudal peduncle; (2) that the throat and chest, and the median line below, at least as far back as the anus, is varied to a greater or less extent with white spots, streaks, and larger areas; (3) that the pectorals have the lower surface practically all white, but the upper surface varied white and black, in some cases almost entirely black, in other cases the distal three fourths or nearly the whole surface white; (4) that the flukes are largely black above, more or less white below.

Exactly the same style of coloration and the same variations were found in three Humpbacks which I examined at the Snook's Arm Station, Newfoundland, in 1899 (see pls. 37–39). These presented the following characteristics:

No. 5. Male. Aug. 9, 1899. (Plate 37.) Upper jaw, back and sides, black. Part of the lower jaw, the throat, and chest to the line of the pectorals, with spots, rings, crescents, streaks, and larger areas of white, the two largest areas being just below the middle of the right side of the lower jaw, and in the median line between the pectorals. The streaks were chiefly in the furrows, while the rings and crescents were confined to the ridges and the jaw. These rings appeared to mark the location of barnacles. The margins of the ridges posteriorly were also spotted with white, but less distinctly than in front. From the genital orifice to the insertion of the flukes, the inferior median line was thickly covered with round

white spots, also apparently due to barnacles. These spots extended up a considerable distance on the sides of the caudal peduncle.

The upper surface of the pectorals was entirely white, except for a short distance at the root; the posterior margin was occupied by an irregular, interrupted black line, consisting of round black spots thickly massed together; on the anterior margin the knobs or protuberances were black, and were occupied by clusters of barnacles. The lower surface of the pectorals was entirely white, except the protuberances and a narrow, poorly defined posterior margin, and the tip, which were black.

The flukes were black above; below white, with a semicircular black area surrounding the mesial notch and a similar and larger one invading the white from the caudal peduncle. The extreme tips and the protuberances along the posterior margin were also black, and the anterior margin for about 3 in. deep. The dorsal fin was black, with a few white spots on the free margin and sides. A white spot behind the eye, and another on the upper lip, near the apex of the jaw.

No. 6. Female. Aug. 6, 1899. (Plate 39, figs. 2, 3.) Similar to the last, but with much less white. Upper jaw, back, and practically the whole of the body above and below, from the line of the pectorals backward, black. Throat and chest strongly varied with white spots, streaks, and blotches, the largest below the middle of the left side of the mandible. The posterior half of the pectoral ridges almost completely black, with only a few scattered white spots. Only a few white spots at the navel and around the genital orifice. Margin of lower jaw black. Upper jaw with a white spot near the anterior end.

Upper surface of the pectorals almost entirely black in the proximal half, and in the distal half varied with white and black in equal proportions. Lower surface entirely white.

Flukes black above; white below in the center of each lobe, with broad black antero-posterior mesial band and margins.

Dorsal fin black, with a few white spots on the anterior margin.

No. 21. Female. Aug. 18, 1899. (Pl. 40, fig. 3.) Less white than in either of the preceding specimens. The white markings of the body confined almost entirely to the throat, and consisting chiefly of rings. A few white marks extending along the median line of the breast as far as the line of the pectorals. A few white spots about the genital orifice and on the inferior margin of the caudal peduncle.

Upper surface of pectorals entirely white except at the root and along the posterior margin and on the protuberances; lower surface white, except for a narrow irregular posterior black margin, and black tip.

A young female taken at Provincetown, Mass., in 1879, as shown by photographs and sketches in the National Museum (pl. 41, fig. 6), had the upper surface of the pectorals white, with a black mark extending along the axis from the root about half way to the tip, but not wide enough to reach the margins of the fin; the posterior margin with irregular black marks; anterior margin white, except on the larger protuberances; lower surface closely resembling the upper. Flukes black above; below, with a large white central area on each lobe, surrounded

by a broad black border, and separated in the median line by a broad black band reaching forward from the notch to the caudal peduncle.

It is evident, from a comparison of these several descriptions, that there is no important difference in coloration between the American and the European specimens. The principal one to be noticed is contained in Sars's statement that the flukes of the Finmark whale were black below, as well as above, with rings of white along the posterior margins. Cocks also describes one Finmark specimen as having the flukes black below. As he describes another having a part of the under side of the flukes white, and as the Tay whale (Scotland) had the flukes white below, it is not likely that this point is of importance.

The color of the Greenland Humpback, or *Keporkak*, was described by Eschricht (*37*, 71, 146, and 198) from the data given by Fabricius, Holböll, and Motzfeldt. His statement is as follows:

"In the *Fauna Groenlandica*, Fabricius says of the Keporkak: 'Color of all the upper parts, black; of the throat, pectorals and under side of the flukes, white; bases of the abdominal folds blood-red, but the ridges between them, and even the whole abdomen and the flukes below, variegated black and white.' Somewhat briefer and clearer is his account in the Danish publication (*Stubhval*, p. 10): 'The color is black on the whole upper half; on the lower, white with black flecks, as if variegated; but the chin and the pectorals entirely white, and the bottom of the furrows blood-red.' Still more definitely speaks Motzfeldt. 'The pectorals of the Keporkak are entirely white; the flukes white on the under surface, with a black border; both occupied by barnacles.'"

From these descriptions it would appear that the *Keporkak* does not differ in coloration from the Humpback of Newfoundland and Europe. The pectorals are said to be entirely white, whereas in the Newfoundland and European specimens there was always more or less black at the root. In the whiter specimens, however, this would be overlooked in a general survey, and the pectorals would be cited as entirely white.[1]

In 1868, Hallas described a male Humpback 43 ft. long, found dead and floating on the sea, between Ingolfshöfde and Portland, on the south coast of Iceland (*60*, 172). His description, which is brief and concise, may be presented in translation here:

"The color of the head and back was everywhere shining black, as also the sides of the body. On the part of the belly between the penis and flukes, where the skin is smooth, the color was also black, with some irregularly-placed white spots. The ridges on the throat, breast, and belly were black, but the color dull, and snow-white spots were found scattered irregularly here and there over the whole surface. The ridges in the median line of the belly approached within 15 inches [Danish] of the penis and decreased in length on the sides; they divided many times. The breadth of the ridges was 2–2½ inches [Danish], the depth of the furrows between was 1–1½ inches [Danish]; their color light gray.

"The pectoral fins in the upper third of their outer surface were shining black, in the middle third also shining black, but with irregularly placed snow-white spots, and in the lowest [distal] third entirely white. On the inner surface the upper

[1] See Sars (*80*, 15).

third was shining black, but the remainder all snow-white. The anterior border was thick and rounded, but irregularly emarginated and covered with numerous examples of *Coronula diadema;* the hind margin sharp and entire.

"The dorsal fin was shining black.

"The flukes were black on the upper surface, with a number of scattered, irregular snow-white spots; on the lower surface, the ground color of which was shining black, these snow-white spots were more numerous. The anterior border of the flukes was thick and rounded, the posterior margin, strongly emarginate and occupied by many examples of *Coronula diadema.*

"The whalebone was all gray-black."

Rawitz (*74*, 89) states that the whalers account for the variation in color on the basis of difference of age. "They say that young animals have a black ventral skin, and the old ones a white skin; the former have little blubber and the latter much." He is inclined to accept this explanation, as the four specimens he examined seem to support it. He remarks: "We should have then, were this explanation correct, the highly interesting physiological phenomenon before us, that with increasing fat in the corium (*unterhaut*), the pigment in the epidermal cells completely disappears."

In order to test this theory I have arranged below the 13 specimens from different parts of the North Atlantic in the order of size, the smallest first. In the table, the letter W signifies that a part is white, V signifies that it is varied, part white and part black, and B signifies that it is entirely black, or substantially so.

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. COLORATION.

Author.	Sex.	Total Length.	Color of Throat.	Color of Breast.	Color of Belly.	Color of Pectorals.		Color of Flukes.	
						Above.	Below.	Above.	Below.
Cocks	...	30′ 0″	B	B	B	W	W	..	..
Rawitz	♀	34′ 5″	B	B	B	B	W	B	W
Cocks	♂	35′ 0″	B	B	B	W	W	..	..
Struthers	♂	38′ 0″	B	B	B	..	W	..	W
Cocks	....	40′ 0″	W	..	..	B	W	..	part W
Rawitz	♂	41′ 0″	B	B	B	W	W	V	W
"	♂	41′ 8″	V	V	V	W	W	V	W
Cocks	♂	42′ 0″	W	W	B	W	..	..	..
True	♂	42′ 2″	V	V	B	W	W	B	W
Cocks	....	44′ 0″	B	V	B	¼ B	W	..	..
True	♀	45′ 5″	V	V	B	½ B	W	B	W
"	♀	46′ 6″	V	B	B	W	W	..	..
Rawitz	♀	46′ 9″	W	W	W	W	W	W	W

Assuming that the thirteen specimens belong to the same species, the foregoing table lends some support to Rawitz's theory, as the youngest specimens all have the throat, breast, and belly entirely black. It will be noticed, however, that my Newfoundland females, which were adults, were but little white, so that it would appear that whiteness is not invariably assumed by mature individuals, and may be rather a sign of senility. There is probably a considerable individual variation in this regard, as there certainly is in other genera. Rawitz's largest

specimens seem to have been rather unusually white. More evidence is required before Rawitz's tentative hypothesis can be accepted.

In the majority of the descriptions of European Humpbacks the color of the dorsal fin is not specified. Van Beneden states that the posterior part is white (7, 113). Sars represents it as dark like the back. In Newfoundland specimen No. 5, the dorsal was black with small irregular white marks; in No. 6, the dorsal was blotched and spotted with white on the anterior margin; in No. 21 also there was some white on the anterior margin.

PROPORTIONS.

While at the Snook's Arm whaling station, Newfoundland, in 1899, I made measurements, as already stated, of three Humpbacks, one male and two females.

These measurements are given in the following table:

MEGAPTERA NODOSA (BONNATERRE). NEWFOUNDLAND.

Measurement.	No. 5, ♂, Aug. 9, 1899. Snook's Arm, Newfoundland.	No. 6, ♀, Aug. 9, 1899. Snook's Arm, Newfoundland.	No. 21, ♀, Aug. 18, 1899. Snook's Arm, Newfoundland.
Total length from tip of snout to notch of flukes	42′ 2″	45′ 5″	46′ 6″
Tip of snout to posterior insertion of dorsal fin	28′ 9″	30′ 2″	32′ 8″
" " " " anterior " " " "	24′ 11″	.....	.....
" " " " eye (center)	10′ 6″	11′ 2″	11′ 6″
" " " " blowhole	8′ 2″	8′ 4″	.....
" " " " anterior insertion of pectorals	13′ 4″	16′ 0″[1]	14′ 2″
" " " " axilla	.....	17′ 0″	.....
" " " " ear	.....	.....	13′ 1″
Vertical height of dorsal fin	0′ 12″	0′ 12″	.....
Breadth of flukes	15′ 8″	17′ 4″	.....
From notch of flukes to anus	10′ 6″	10′ 11″[2]	11′ 5″
" " " " " root of penis	14′ 6½″	.....	.....
" " " " " clitoris	.....	12′ 9″	13′ 7″
" " " " " navel	17′ 10½″	19′ 0″	19′ 8″
Length of pectoral from head of humerus	14′ 2″	15′ 2″	14′ 1″
" " " " posterior insertion, or axilla	12′ 2″	12′ 9″	.....
Greatest breadth of pectoral fin	3′ 2½″	.....	3′ 6″
Broadest pectoral ridge	0′ 8″	0′ 5″	0′ 6″
Depth of caudal peduncle at insertion of flukes	3′ 1″	3′ 4″	.....
" " flukes at root (antero-posterior)	3′ 7″	4′ 3″	.....
Length of protuberances on upper jaw	0′ 4½″	.....	.....
Breadth " " " " "	0′ 2″	.....	.....
Length of longest whalebone without the bristles	1′ 9″	1′ 10″	.....
" " dorsal fin	.....	5′ 1″	.....
" " orifice of the eye	.....	0′ 3″	.....
" " iris	.....	0′ 1½″	.....
Semi-circumference of body opposite navel	.....	.....	14′ 11″

[1] To head of humerus. [2] Center.

These measurements reduced to percentages of the total length, and accompanied by similar ones for European specimens, including the type of *M. longimana* Rudolphi, are given in the following table:

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN.

	Iceland. 1867. (Hallas, 1868.)	Finmark. (Sars, 1880.)	Vardö, Finmark. 1884. (Cocks, 1885.)	Vogelsand, Germany. Type *M. longimana*. (Rudolphi, 1832.)	Vardö, Finmark. Aug. 20, 1885. (Cocks, 1886.)	Vardö, Finmark. 1884. (Cocks, 1885.)	Tay River, Scotland. 1883. (Struthers, 1889.)	Dee River, England. 1863. (Moore, 1863.)	Sligo Co., Ireland. March, 1893. (Warren, 1893.)	Snook's Arm, Newfoundland. No. 21. 1899.	Snook's Arm, Newfoundland. No. 6. 1899.	Snook's Arm, Newfoundland. No. 5. 1899.	Cape Cod, Mass. (13656, U. S. N. M.)
Sex and age	♂	♀	♂	♂		♂	♂	♀ jr.		♀	♀	♂	♀ jr.
Total length	51′ 6″ [1]	46′ 7″ [2]	44′ [4]	43′ [5]	42′	40′ [4]	38′ 0″ [7]	31′ 4″	29′ 1″	46′ 6″	45′ 5″	42′ 2″	32′ 5½″
	%	%	%	%	%	%	%	%	%	%	%	%	%
Tip of upper jaw to eye	.....	25.4 [2]	.....	23.3	.....	.....	23.3 [7]	25.5	.....	24.7	24.6	24.9	21.5
Tip of upper jaw to blow-hole	25.8	18.3	18.0 [4]	.....	19.4	.....	17.3 [7]	.....	15.8 [10]	.....	18.4	19.4	18.7
Tip of upper jaw to pectoral	.....	.....	.....	31.6	.....	.....	31.6 [8]	35.1	.....	30.5	35.2 [11]	31.6	28.4
Tip of upper jaw to back of dorsal	.....	67.6	.....	67.5	.....	.....	[67.5] [9]	67.8	64.7	70.3	66.4	68.2	70.6
Tip of lower jaw to corner of mouth	.....	.....	.....	27.9	23.4 [6]	.....	24.6	25.5	.....	.....	.....	.....	22.0
Notch of flukes to anus	.....	25.8 [3]	.....	.....	.....	.....	.....	.....	.....	24.5	24.0	22.9	.....
" " " " navel	.....	44.4 [3]	.....	[40.7]	.....	.....	.....	.....	.....	42.3	41.8	42.4	.....
Length of pectoral from axilla	29.1	31.0	31.3 [4]	30.3	.....	.....	27.0	.....	.....	.....	28.1	28.9	28.4
Length of pectoral from head of humerus	33.0	.....	34.1 [4]	.....	30.8	28.3 [4]	31.6	32.0	31.5	30.3	33.4	33.6	.....
Greatest breadth of pectoral	7.0	7.0	8.1 [4]	7.0	.....	7.9 [4]	7.1	.....	.....	7.5	.....	7.6	6.1
Height of dorsal	1.2	2.1	.....	.....	.....	.....	2.4	.....	1.9	.....	2.2	2.4	2.5
Breadth of flukes, tip to tip	30.0	34.5	.....	32.6	.....	37.5 [4]	30.0	35.1	30.9	.....	38.2	37.0	27.1
Height of body at pectorals	.....	27.4	.....	[29.3]	.....	.....	.....	.....	.....	.....	.....	.....	.....
Height of body between flukes and dorsal	.....	.....	.....	[9.3]	.....	.....	.....	.....	.....	.....	.....	.....	.....

NOTE.—Rawitz's measurements of four specimens observed by him at Bear Island, Norway, reduced to percentages of the total length, are as follows:

	1. ♀	2. ♂	3. ♂	4. (?)
Total length	46′ 5″	41′ 4″	40′ 8″	34′ 1″
Tip of lower jaw to corner of mouth	29.7%	.....	.....	23.0%
Length of pectoral from head of humerus	35.3%	31.7%	32.3%	35.7%
Height of dorsal	2.1%	.....	.....	.....

[1] Danish measure.
[2] Straight, from lower jaw.
[3] From figure.
[4] Approximate.
[5] Rheinland measure.
[6] From upper jaw.
[7] From measurements given on a photograph and in pamphlet "Story of the Whale."
[8] From "Story of the Whale,"—to shoulder. Struthers gives 34.2%.
[9] "Story of the Whale" gives [71.3%].
[10] Cannot account for this small measurement.
[11] To head of humerus.

It will be seen that there is a very close agreement between the principal measurements of the Newfoundland and European specimens, and especially between the former and the Tay River (Scotland) specimen. The only departure of importance is in the breadth of the flukes, which are made to appear wider-spread in the Newfoundland specimens. In the case of No. 6 the flukes were cut off before the whale was brought to shore, and I had to rely on measurements not my own. It is quite likely that they were taken in some other manner than direct from tip to tip. In the case of No. 5, one of the flukes only was in position when the whale was drawn up on the slip. The measurement given is, therefore, really an estimate. The same lack of conformity will be found in the case of *Balænoptera physalus*, and for the same reason.

It is to be regretted that fuller measurements of European specimens are not obtainable, but as the species appears to strand but rarely on that side of the Atlantic, few observations have been recorded.

ABDOMINAL RIDGES AND FURROWS.

The system of abdominal ridges and furrows is simple in the posterior part, but complicated at the anterior end, and better understood from illustrations than from descriptions (see plates 37–39). The description of the Tay River (Scotland) whale given by Struthers, and the description and figure of the Finmark whale given by Sars agree with the Newfoundland specimens. In the former the ridges were $4\frac{1}{2}$ or 5 in. wide; in the three Newfoundland specimens the widest were 8, 5, and 6 inches respectively. In Hallas's Iceland Humpback (*60*, 172) the ridges were 2–$2\frac{1}{2}$ in. (Danish) in breadth, which, if correct, is a notable difference. The ridges are not exactly symmetrical on the two sides of the body and the different ridges anastomose at different points. The ridges and furrows farthest from the median line run forward to the inferior margin of the mandible, but the median two or three pairs curve inward at the anterior end and unite considerably farther back, forming a sort of median ridge, which Struthers likens to a "second chin." (See pl. 39, fig. 1.) This disposition of the ridges, and the other characteristics mentioned above, were found in the Tay whale. In the Newfoundland specimens many of the furrows were divided longitudinally by a narrow, central supplementary ridge, triangular in section. Other furrows contained similar short ridges arranged diagonally. As already stated, the majority of the furrows terminate anteriorly below the margin of the mandible, but those most distant from the median line extend on to the proximal end of the smooth surface of the mandible itself.

In the three Newfoundland specimens there were 14, 20, and 22 ridges, respectively, on the breast between the pectoral fins. In the Tay River whale the number of ridges, according to Struthers, was about 24. Sars states that the number in the Finmark whale was between 20 and 30. Rawitz's largest specimen (14.25 m.) had 22 furrows, while the smallest (10.5 m.) had 36 furrows. He does not state at what point or how the count was made.

Besides the furrows, properly so called, the Newfoundland specimens displayed

one or two furrows running out of the corner of the mouth and passing backward across the root of the pectoral fin. (See pl. 37, fig. 3.) These were sometimes limited posteriorly by two or three short furrows running transversely, so that the pectoral fin was marked off from the body by an almost continuous depression. In one instance there were five or six short furrows across the proximal end of the upper surface of the pectoral fin, and also a longitudinal furrow above the eye. (See pl. 39, fig. 2.) In none of the five specimens examined (including two fœtuses) were these lines exactly alike in detail. Similar lines about the pectoral are shown in Sars's figure of the Finmark specimen (*80*, pl. 2).

DERMAL TUBERCLES.

It is characteristic of the Humpback whales to have a number of hemispherical tubercles on the snout and mandible. Those on the snout are arranged in three rows, one median and two lateral. The lateral rows are irregular and in each the tubercles are arranged somewhat in pairs. On the mandible there is a cluster of tubercles on each side of the symphysis and others scattered along the jaw in about three irregular rows.[1] The tubercles are elongated. In the Newfoundland specimen, No. 5, the larger ones were 4½ in. long, 2 in. broad.

In the Tay River whale there were 7 tubercles in the median line of the snout, 8 on the right lateral row, and 11 on the left lateral row; on the mandible, 6 on each side of the symphysis, and 6 more along each side of the jaw; in all, 26 on the upper jaw, 24 on the lower.

In the Finmark whale a similar arrangement of tubercles is described by Sars: a median row, and a double row on each side. The number, size, and shape appear to be incorrectly given in his figure (*80*, pl. 2), which has been copied in the Encyclopædia Britannica, 9th ed. (Art. *Whale*).

Rawitz (*74*) states that in the Bear Id. Humpbacks examined by him there were 26 tubercles on the upper jaw and from 13–19 on the lower jaw.

In the Newfoundland specimen No. 6 there were 4 or 5 in the median row on the snout, one on the wall of the blowhole, and from 10 to 13 in each lateral row; on the mandible, 5 on each side of the symphysis, and about 12 additional on each side of the jaw; making in all from 24 to 31 on the upper jaw, and about 34 on the lower jaw.

In No. 5 (pl. 37, fig. 3) there were about 24 on the upper jaw, and 28 on the lower jaw. In No. 21 (pl. 39, fig. 4) there were about 5 large tubercles on each side of the symphysis of the mandible, and about 5 smaller ones on each side of the jaw. The number on the upper jaw was not observed.

Eschricht's figure of the fœtal Greenland Humpback shows 5 tubercles in the

[1] Rudolphi (*76*, 135) states that the type of *B. longimana* was without tubercles on the head, and the figure which he gives shows this condition. It is not certain by whom this supposed character was observed. Rudolphi does not state that he saw the exterior of the specimen. The figure was drawn by C. L. Müller, and shows numerous inaccuracies, among which are the large size of the dorsal fin, the curvature of the rostrum, the position of the eye, etc.

median line of the snout, 4 about the blowhole, 9 in the right lateral row, and 8 in the left lateral row; making a total of 26, the same number as in the Tay whale.

In the Iceland Humpback examined by Hallas (*60*, 174) there were 24 dermal tubercles on the head, of which 5 stood in the median line, 10 on the right side, in two rows, and 9 on the left side, also in two rows. On the mandible were 21 tubercles, of which 11 were on the right side in a single row, and 10 on the left side.

From these observations it is evident that while the tubercles are indefinite in number and exact location, their general arrangement is the same in the Humpbacks of both sides of the Atlantic.

DORSAL FIN.

In the Newfoundland specimen, No. 5, the dorsal fin was erect and falcate, with a concave posterior margin. The upper part of the anterior margin was also concave, as if from an injury which had removed a portion of the fin and destroyed the regularly falcate shape. This may, however, be an individual variation. (See pl. 37, fig. 1.) In specimen No. 6, Newfoundland, the dorsal fin was similar to that of No. 5, but the anterior margin was regularly convex, and the posterior margin almost straight. There was nothing in the shape of the dorsal in these specimens suggesting a boss or knob. The fin was erect and prominent, like that of a dolphin or Finback whale, but thicker at the base.

In the fœtus from Newfoundland specimen No. 6, the dorsal was somewhat falcate, the tip curved backward, the posterior margin with a moderate concavity or rather S-shaped, on account of a convexity at the base. The tip was not thickened.

The dorsal fin of the Tay River whale, as figured by Struthers (*87*, pl. 2, fig. 2) was low, reclined, and rounded; the anterior margin convex, and the posterior straight or slightly convex. (See text fig. 72.) The photograph of this whale in my possession, on the contrary, shows the fin prominent, erect, and somewhat falcate, exactly as in the Newfoundland specimens.

Eschricht figured the dorsal fin of a Greenland Humpback, or *Keporkak*, which was sent him in salt by Capt. Holböll (*37*, pl. 5, fig. 1). This figure represents the fin as an obtuse, thick mass, with an irregularly convex posterior margin. I find it impossible to escape the feeling that this fin was imperfect either from injury or imperfect preservation, or both. Sars has already expressed the same opinion (*80*, 13).[1] Eschricht published two figures of a fœtal *Keporkak* (*37*, pl. 3, figs. 1, 2), neither of which is like the dorsal of the adult. One of these figures (fig. 2) is an enlargement of the dorsal of the fœtus represented in the other (fig. 1). It is

[1] Sars's comment is as follows: "The figure of the dorsal of a Greenland specimen given by Eschricht from a preparation in salt is, as already said, quite essentially different [from the normal shape] and has rather the form of a low fatty lump than that of a real fin, which led Eschricht to give the whale the Danish common name 'Pukkelhval' (Hump-whale). It is likely that the part undergoes important variation in different individuals. Yet I should be more inclined to the opinion that the example from which the dorsal described by Eschricht was derived had suffered some sort of injury in that part, whereby the dorsal became deformed."

not exactly the same, having a much straighter posterior margin and a knob-like tip joined to it in a manner which makes the figure appear diagrammatic. The dorsal on the fœtus itself (*37*, pl. 3, fig. 1) is short, erect, and has a slightly concave

FIG. 68.

FIG. 69.

FIG. 70.

FIG. 71.

FIG. 72.

MEGAPTERA NODOSA (BONNATERRE). PECTORAL AND DORSAL FINS.

FIG. 68.—TAY RIVER, SCOTLAND. BONES OF PECTORAL FIN. (FROM STRUTHERS.) FIG. 69.—PROVINCETOWN, MASS. EXTERIOR OF PECTORAL FIN. (FROM A PHOTO.) FIG. 70.—GREENLAND. DORSAL FIN OF A FŒTUS. (FROM ESCHRICHT.) FIG. 71.—THE SAME, ENLARGED. FIG. 72.—TAY RIVER, SCOTLAND. DORSAL FIN. (FROM STRUTHERS.)

posterior margin like adult Newfoundland specimens, but of course more undeveloped. (See text figs. 70, 71.)

Holböll describes the dorsal of the adult *Keporkak* (*37*, 76) as "low, broad on the side, cut off almost straight toward the tail; in general, shaped like a broad lump of fat with a knob." Fabricius describes it as "compressed, with a broader base, the apex a little acute, in front sloping upward (*sursum repanda*), behind almost perpendicular," but adds "some are obtained, however, which have the apex equally curved, in some longer, in others shorter." Motzfeldt's description of the dorsal fin is as follows (*37*, 198): "The dorsal fin of the *Keporkak* has as a very salient character a protuberance or knob on the anterior (upper) margin."

Brandt describes the dorsal fin of the Humpback as having "a convex upper border, gradually rising, ending at its highest point behind and above in an obtuse backward-curved tip, below which is a considerable emargination, . . . and then gradually merging into a ridge running forward from the tail."

Sars's figure of a Finmark Humpback (*80*, pl. 2) shows the dorsal fin strongly concave posteriorly. His description is as follows:

"As in some species of the genus *Balænoptera*, it is compressed like a scythe, with a rather thick and strongly convex anterior border, and a thin, sharp, and

evidently concave posterior border. The tip, which is rather obtuse, is strongly bent backward, so that the whole fin shows a considerable resemblance to that of the *Vaagehval* [*Balænoptera acuto-rostrata*]."

From the foregoing discussion it would appear that there is no constant difference between the Newfoundland, Greenland, and European Humpbacks as regards the shape of the dorsal fin, unless it be that in the Greenland animal, or *Keporkak*, the tip is thicker. As in the Finbacks, the shape of the dorsal appears to vary to a large extent in different individuals.

Hallas figured the dorsal of an Iceland Humpback (*60*, 173) as sloping and convex or straight posteriorly, much as in Eschricht's Greenland *Keporkak*.

The different American and European specimens show a remarkable uniformity in the height of the fin, which varies only between 1.9 % and 2.5 % of the total length of the body. As regards its position, there is, on the other hand, a lack of uniformity. After making due allowance for difference in manner of taking measurements, etc., it still appears probable that the fin is not always situated at exactly the same relative distance from the head. No two observers agree as to the length of the base of the fin. This is because the margins pass by imperceptible gradations into the general contour of the back.

Rawitz (*74*, 82) repudiates the idea that the dorsal resembles a bunch, and states that in the Bear Id. specimens which he examined the fin had a strongly convex anterior border bent backward, and the posterior border concave forward. He asserts that the white color on the dorsal of the Greenland *Keporkak* described by Eschricht was probably due to post-mortem changes because his four Bear Id. specimens had entirely black dorsals. It is a fact, however, that the Newfoundland specimens had white marks on the dorsal fin.

THE PECTORAL FIN.

The form of the pectoral is one of the most peculiar characters of the Humpback, while in length it exceeds the pectorals of all other whales. The fin is long, narrow, and thin. On the anterior (upper, or radial) margin it presents a number of protuberances, which together with the emarginations between them, produce a serrated outline. There are similar protuberances on the posterior (or ulnar) margin, especially at the distal end, but less in number, and much less prominent. In the fœtus the protuberances are all very strongly marked, and are made more striking (in Newfoundland specimens) on account of their being lighter in color than the general surface of the fin. In shape and texture they remind one not a little of the tubercles on the head.

Eschricht (*37*, 79) and Struthers (*89*, 5) by their descriptions and figures have made plain the connection of the anterior protuberances with the internal structure of the fin. Each protuberance marks the position of a cartilage of the manus.

The two largest, namely, the one at the proximal end of the series, and one about midway, mark the position, respectively, of the distal epiphysis of the radius, and the terminal cartilage of the anterior (2d) digit. The protuberances between these larger ones mark the position of the intermediate cartilages of the 2d digit, while those beyond mark the position of the cartilages of the 3d digit.

In both Eschricht's figure of the Greenland Humpback (*37*, pl. 3, fig. 4) and Struthers's figure of the Tay River whale (*87*, pl. 3, fig. 6), there are 10 anterior tubercles, one for the carpus, or distal end of the radius, 3 for the 2d digit, and 6 for the 3d digit.

There were exactly the same number and the same arrangement in the Newfoundland adults and in the fœtus taken from Newfoundland specimen No. 21. In the fœtus from Newfoundland specimen No. 6, there are 11 projections, with the same arrangement,—*i. e.*, one large proximal one, then 2 moderate-sized, then one large, and finally 7 small, including the tip of the fin.

Eschricht's figure of the fœtus of the *Keporkak*, or Greenland Humpback, shows 8 small protuberances at the extreme distal end of the posterior, or ulnar, margin of the pectoral. The fœtus of Newfoundland specimen No. 21 has the same number. In addition there are two large elevations near this margin (which can hardly be compared with those on the anterior margin), one opposite the pisiform cartilage, or the distal end of the ulna, and one at the distal end of the 5th digit. These are not represented in Eschricht's figure.

The protuberances of the anterior, or radial, margin and those at the end of the ulnar margin are preserved in the adult, and give the fin its remarkable outline. In most specimens each protuberance is occupied by a cluster of barnacles. The clusters are often confluent on both sides of the distal extremity of the fin, forming a continuous edging. They are always surrounded by black. The proximal two thirds of the posterior margin of the fin is nearly free of barnacles. This margin presents a sigmoid curve, convex proximally, concave distally, with the tip directed backward. Except at the distal end, this margin is even and thin, contrasting strongly with the thick, sinuous anterior margin.

The same peculiarities are seen in the Tay River (Scotland) whale, Sars's Finmark specimen, and Eschricht's Greenland specimen, and in the young female from Cape Cod, Mass., in the National Museum (pl. 41, fig. 6).

In four European Humpbacks, as seen by examining the table on p. 223, the pectoral fin, measured from the head of the humerus, bore the following proportion to the total length :

Finmark	30.8 %	Cocks
Ireland	31.5 %	Warren
Tay River, Scotland	31.6 %	Struthers
Dee River, England	32.0 %	Moore

Rawitz gives the following as the relative length in four Humpbacks measured by him at Bear Id. (*74*, 82) :

(1) 35.7 %; (2) 32.3 %; (3) 31.7 %; (4) 35.3 %.

In the three Newfoundland Humpbacks which I measured the proportion was as follows :

(1) 30.3 %; (2) 33.4 %; (3) 33.6 %.

It thus appears that there is a very considerable variation in the length of the pectoral fin in both European and American Humpbacks. Rawitz's largest measurements are larger than any others I have found.

THE CAUDAL FIN, OR FLUKES.

The caudal fin in the Newfoundland Humpbacks has a regular, thick, convex anterior margin, and a thin, sinuate posterior margin, with numerous small finger-like processes, with deep emarginations between them. The tips are recurved. In the fœtuses of No. 21 and No. 6 the processes of the posterior margin were very numerous, prominent, and acuminate, producing a singular fringed appearance. It is evident that this appearance in the adult is not the result of injury, but a natural character. In the 30-foot specimen from Cape Cod, Mass., in the National Museum, these processes are very numerous and conspicuous (pl. 40, fig. 2). They were also found in the adult Newfoundland specimens.

The same shapes and processes are seen in Struthers's figure of the flukes of the Tay River whale, in Sars's Finmark specimen, and in Eschricht's figure of a fœtal Greenland Humpback. The tips of the flukes are commonly occupied by barnacles.

OUTLINE OF THE CAUDAL PEDUNCLE.

That portion of the body between the anus and flukes (called "the small" by whalers), which corresponds to the tail in land mammals, has a straight superior margin, but the inferior margin is broken by depressions and elevations.

In the Newfoundland female No. 21, the sexual orifice is surrounded by thick protuberant walls, causing a convexity in the inferior outline of the body. The orifice is preceded by a transverse groove, and terminates posteriorly in a hemispherical boss, behind which is a second transverse groove in which the anus is situated. Behind the anus is a rounded elevation, terminated by a third deep transverse groove and followed by a prominent compressed elevation or carina. The same arrangement of parts is found in female No. 6. (See pl. 39, fig. 3.) In male No. 5, the outline is similar. The penis is contained in a rounded elevation, and another keel-like, compressed elevation appears behind the anus. These elevations are also seen in a photograph in the National Museum representing a male Humpback at Provincetown, Mass. (See pl. 40, fig. 1.)

Exactly the same form is represented in Sars's figure of a Finmark female as occurred in the Newfoundland females.

EYE.

Rawitz (*74*, 79) states that in the Humpbacks examined by him at Bear Id. the iris of the eye was dark brown, the pupil kidney-shaped, with the long axis fore and aft.

WHALEBONE.

The whalebone of the European Humpback is described by Van Beneden as black, with black bristles; but this is not correct. Sars (*80*, 11) describes it as "all, as well on the upper as the lower side, of uniform gray-black color, with some lighter fibres." Struthers's description is more detailed, as follows (*87*, 13):

"In colour, the whalebone on the outside was black, except along the front 12 inches where it was partly white, mottled, but differing in this respect on the right and left sides. On the left jaw here, at 6 inches from the mesial line, 15 plates are quite white on their anterior [outer] half but black on the palatal half. Some near these, again, have the anterior edge black, and the rest of their surfaces white. Viewed from the palatal aspect, the whole matting of hairs was whitish. The words in my note-book are 'white, dirty-white, or yellow-white.' Now, in 1887, after 3 years' exposure, though washed clean, that description could not apply. The colour of the hairy matting now is dirty-brown mixed with brown-black. The hairs are fully 4 inches in length, some 6 inches. The hairs of the fringe are thick and stiff, like bristles, compared with those of my 50-feet-long *B. musculus* [=*B. physalus*], but the much finer hairs of the matting on the palatal aspect do not differ in thickness in these two whales."

This description applies well to the Newfoundland Humpbacks which I observed in 1899. In No. 5, ♂, the right whalebone was all grayish-black, except from the anterior end backward about one foot, where it was dull whitish. The bristles along the exterior were of the same grayish-black color, but their matted interior surface was lighter, with here and there a small area still much lighter. In No. 6, ♀, the most internal bristles were gray-brown, the next lot exteriorly, whitish, then a pale pink-gray band, and finally the exterior ones part whitish and part gray. The general effect in looking into the mouth was that of dark gray for 4 inches next to the roof of the mouth, succeeded by lighter color. A few anterior blades of whalebone were white externally. In both specimens the external edge of the blades was very rough, much more so than in *Balænoptera physalus*.

Eschricht describes the whalebone of the Greenland Humpback as "entirely dark in color, when dry black-brown or black, the bristles brownish" (*37*, 147). In another place he remarks: "I have received more or less complete sets of whalebone of many young and old *Keporkaks*, part in brine, part dried. They were all dark colored, when dried almost black, when preserved moist in salt, the small internal plates (*Nebenbarten*) more or less gray in part, the bristles almost always brown. On each side are about 400 plates. The length of the whalebone scarcely exceeds 2 feet" (*37*, 93).

The size of the whalebone in different European and American specimens is shown in the following table:

BALÆNOPTERA ACUTO-ROSTRATA LAC. EUROPEAN AND AMERICAN WHALEBONE.

Locality.	Length of Whale.	Length of Longest Whalebone.	Length of Longest Bristles.	Greatest Breadth.	Author.
		in.	in.	in.	
Tay River, Scotland	40′ 0″	20	5	5	Struthers
Norway	.....	24 ±	..	..	Guldberg
Greenland	.....	24 ±	..	..	Eschricht
Dee River, England	31′ 0″	24[1]	..	..	Moore
Notre Dame Bay, Newfoundland	42′ 2″	21	..	..	F. W. T.
" " "	45′ 5″	22	..	..	F. W. T.

[1] "Nearly 2 feet long."

OSTEOLOGY.

Several skeletons of Humpbacks from the east coast of North America are preserved in the museums of the United States. I have examined the type of *Megaptera osphyia* Cope, taken off the Maine coast, the type of *M. bellicosa* from the West Indies, and two skeletons in the National Museum from Cape Cod, Mass., viz.: No. 16252, young female, and No. 21492. For the Greenland Humpback, we have Eschricht's description and figures (*36* to *39*). For the European Humpback, the best descriptions are Rudolphi's account of the type of *M. longimana* (*76*), and Struthers's elaborate study of the Tay River, Scotland, whale (*87*). Flower's well-known paper on the skeletons in the museums of Holland and Belgium contains valuable information (*45*); also Van Beneden and Gervais's Ostéographie (*8*), Fischer's Cétacés du Sud Ouest de la France (*44*), and other works of European naturalists. (See pls. 29 to 36.)

NUMBER OF VERTEBRÆ.

The various skeletons of Humpbacks from the North Atlantic, both European and American, thus far examined present the following vertebral formulæ:

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. VERTEBRAL FORMULA.

Locality.	Date.	Sex and Age.	C.	D.	L.	Ca.	Total.	Authority.	Remarks.
Vogelsand, Germany	1824	♂	7	14	11	22	54	Rudolphi	Type of *M. longimana*.
Tay River, Scotland	1883	♂	7	14	10	21	52	Struthers	
Coast of Maine	1844	....	7	14	10	17+	48+	True	Type of *M. osphyia*.
Provincetown, Mass., 16252	1879	♀ jr.	7	14	11	19	51	True	U. S. Nat. Mus.
Cape Cod, Mass., 21492	1878?	....	7	14	10	19+	50+	True	" " "
West Indies	.....	....	7	14	10	20	51	Cope	Type of *M. bellicosa*.
Greenland	....	...	7	14	11	21	53	Eschricht	[Restored.
"	.....	....	7	14	−3	2−[1]	53	Fischer	Louvain Mus.
"	.....	...	7	14	11	21	53[2]	"	Brussels Mus.
"	.....	....	7	14	11	21	53	Lilljeborg	Lund Mus.

The agreement in number of dorsal vertebræ is complete, of lumbars practically so, and of caudals so nearly that the differences may be regarded as individual, or due to imperfection in the specimens. The normal formula would appear to be:

C. 7, D. 14, L. 11, Ca. 21 = 53.

The following, however, is quite likely to occur as frequently, if a larger number of specimens should be examined:

C. 7, D. 14, L.10, Ca. 21 = 52.

[1] Flower (*41*) gives 31.

[2] Van Beneden (*8*, 126) also gives 53 as the total number of vertebræ in this specimen. My own notes on the skeleton, made in 1884, give 52 as the total, and this number is shown in the atlas of the Ostéographie (pls. 10 and 11, fig. 1), viz., C. 7, D. 14, L. 10, Ca. 21 = 52. It is No. 269 in the Brussels Museum.

SKULL.

Measurements of European skulls, which can be compared with one another, have been recorded in the case of the type of *M. longimana* (by Rudolphi) and the Tay River whale (by Struthers).

Measurements of the skull of the Greenland Humpback can be obtained from Eschricht's figure (*39*). Of American specimens, I have measured the skulls of the types of *M. osphyia* and *M. bellicosa*, and of two other specimens from Cape Cod, Mass. These various measurements are brought together in the following table:

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. SKULL.

	Vogelsand, Germany. Type of *M. longimana*. (Rudolphi, 1832.)	Tay River, Scotland. (Struthers, 1889.)	Coast of Maine. Type of *M. osphyia*.	West Indies. Type of *M. bellicosa*.	Cape Cod, Mass. 1879 ? (21492, U. S. N. M.)	Provincetown, Mass. 1878. (16252, U. S. N. M.)
Sex and age	♂	♂	.....	.....	.....	♀ jr.
Total length of whale	43′ [1]	40′ 0″	.....	.....	.....	.....
" " " skeleton.	40′ [1]	39′ 2½″	35′ 5″ [5]	.....	33′ 10″+	27′ 0″
Length of skull (straight)	144″ [1]	125″	135″	114.5″	113″	91″
	%	%	%	%	%	%
Greatest breadth (squamosal)	.....	57.0	58.1	58.8	60.1	58.2
Breadth of orbital process of frontal at distal end (supra-orbital border)	9.0 [2]	9.6	10.4	10.7	8.4	8.2
Length of rostrum (straight)	66.7 [2]	67.6	66.0	66.4	68.6	68.1
Breadth of rostrum at middle (curved)	17.2 [2 3]	22.0	23.3	22.9	22.6	23.0
Length of nasals	7.0 [2]	7.6	.....	7.8	7.0	7.1
Breadth of 2 nasals at distal end	.....	8.2 [4]	.....	.....	7.5 [4]	.....
Length of mandible (straight)	95.8 [2]	96.6	95.5	.....	99.1	96.6
" " " (curved)	.....	104.6	106.7	.....	108.8	107.7
Depth of mandible at middle	.....	8.0	8.5	.....	8.8	8.8

It will be seen that there is no marked difference in the proportions of the American and European specimens (including the type of *M. longimana*) except in a few instances. The breadth of the rostrum in the type of *M. longimana*, measured on Rudolphi's figure, and therefore flat or straight, is considerably less than in the American specimens. That this is probably an error in the figure, rather than a real difference, appears from the fact that in the skull of the Tay River whale the rostrum is as broad as in the American specimens.

The Greenland Humpback, from Eschricht's figure, would seem to have shorter and very much narrower nasal bones than the other specimens (pls. 29 and 32, figs. 1 and 2). It is possible, of course, that this may be a character of the Greenland

[1] Rheinland feet.
[2] From figure.
[3] Straight.
[4] Breadth across distal end of outer margins.
[5] Straight, as mounted; is too much curved and lacks 4 or 5 caudal vertebræ.

Humpback, but it is more likely that the figure is incorrect, as the nasals are made to end against the *inferior* margins of the premaxillæ, which are inclined outward, so as to leave a much wider space between the superior margins. The distance between the superior margins is about 7 %, which is a very close approximation to the breadth of the nasals in other specimens. The inclined position of the premaxillæ in this figure causes the narial space to appear much shorter than in skulls I have examined. Another peculiarity of the figure is the very strong emargination of the orbital processes of the frontal anteriorly, and their emargination posteriorly also. This peculiarity may likewise be a characteristic of the Greenland Humpback, but may, on the other hand, be merely an inaccuracy in the figure. In the absence of any other figure of the upper surface of the skull of a Greenland Humpback it is difficult to decide the points at issue.

VERTEBRÆ.

The proportions of the vertebræ in the Tay River whale, and of some American specimens, including the type of *M. osphyia*, are given in the following table:

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. SKELETON.

	Vogelsand, Germany. Type of *M. longimana*. (Rudolphi, 1832.)	Tay R., Scotland. (Struthers, 1889.)	Coast of Maine. Type of *M. osphyia*. (Niagara Mus.)	West Indies. Type of *M. bellicosa*. (Phila. Mus.)	Cape Cod, Mass. (21492, U. S. N. M.)	Provincetown, Mass. (16252, U. S. N. M.)	Greenland. Lund Mus. (Lilljeborg, 1862.)
Sex and age	♂	♂	.....	.....	.....	♀ jr.	jr.
Total length of whale	.....	40′ 0″	.....	.....	.....	.....	.....
Total length of skeleton	40′ [1]	39′ 2½″	35′ 5″ +	.....	33′ 10″ +	27′ 0″	34′ 6″ [11]
Length of skull (straight)	144″ [1]	125″	135″	114.5″	113.0″	91″	123.5″ [11]
	%	%	%	%	%	%	%
Greatest breadth of axis	.....	17.8	19.3	18.8	18.1	15.4	.....
Depth of centrum "	.....	4.8	5.2	6.1 [6]	.....	.....	.....
Greatest breadth of 1st dorsal	.....	16.2	17.7	17.0	16.4	15.7	.....
Depth of centrum " "	.....	5.7	5.9 (?)	6.6	6.4	.....	.....
Greatest breadth of 1st lumbar	.....	26.0	28.1	25.9	24.4	22.0	.....
Depth of centrum " "	.....	6.6	7.4 (?)	7.0	6.7	7.4	.....
Greatest breadth of 1st caudal	.....	18.8	21.5	22.7	19.7	20.3	.....
Depth of centrum " "	.....	7.9	9.3	8.7	8.4	9.4	.....
Length of sternum	.....	.....	.....	.....	.....	.....	.....
Breadth " "	.....	.....	.....	.....	.....	.....	.....
" " scapula	33.3	33.6	31.3	33.2	31.8	30.7	31.6
Depth " "	22.3	23.2	21.9	23.1	22.6	23.1	21.4
Length of radius (without epiphysis)	23.7 [2]	26.0 [3]	24.3 [5]	25.8	26.3 [7]	28.8 [9]	25.2
Length of ulna (without epiphysis)	.....	22.0 [4]	21.1	21.0	23.0 [8]	24.7 [10]	21.4

[1] Rheinland measure.
[2] From figure.
[3] With epiphyses = 28.8 %.
[4] " " " = 24.0 "
[5] With epiphyses = 25.5 %.
[6] Posterior.
[7] With epiphyses = 28.8 %.
[8] " " " = 24.1 "
[9] With epiphyses = 29.7 %.
[10] " " " = 25.5 "
[11] Swedish; 1 ft. = 297 mm.

With the proper allowance for difference in age, the specimens show a correspondence indicative of specific identity. The positions in the column at which the various processes become obsolete and the arterial foramina appear are as follows:

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. CHEVRONS.

	Tay River, Scotland.	Vogelsand, Germany. (Type.)	Provincetown, Mass. U. S. N. M. No. 16252.	Greenland. Brussels Mus. No. 269.
Last neural spine is on vert. No.....	41	42 [1]	40	42
Last transverse process is on vert. No...	39	38 [1]	38	37

CHEVRONS.

My notes on No. 269 from Greenland, in the Brussels Museum, show that 9 chevrons are in position. The figure of *Megaptera* in Van Beneden and Gervais's Ostéographie (pls. 10, 11, fig. 1) shows 12 chevrons. The young specimen from Cape Cod, in the U. S. National Museum, No. 16252, has 9 chevrons. The Tay River (Scotland) specimen had 10 chevrons.

SCAPULA.

The scapula of *Megaptera* is peculiar on account of its evenly convex superior border and the rudimentary condition of the acromion and coracoid processes. (See text figs. 73–78 and pl. 34, fig. 4; pl. 36, figs. 3–5.)

The percentages of the antero-posterior breadth and of the vertical height (from the margin of the glenoid cavity to the middle of the superior margin) to the length of the skull in various European and American specimens are as follows:

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. SCAPULA.

Locality.	Breadth.	Height.	Remarks.
	%	%	
Vogelsand, Germany.....	33.3	22.3	Type of *M. longimana*.
Tay River, Scotland.....	32.8 [2]	23.2	
Provincetown, Mass. (16252).....	30.7	23.1	
Cape Cod, Mass. (21942).....	31.8	22.6	
Coast of Maine.....	31.2	21.9	Type of *M. osphyia*.
West Indies	31.2	23.1	Type of *M. bellicosa*.
Greenland (Lund Mus.).....	31.6	21.4	

Arranging the measurements of breadth of scapula according to the length of the skull, without reference to locality, we have the following:

[1] From Rudolphi's figure. Type of *M. longimana*.

[2] Left. The right = 33.6 %.

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. SCAPULA.

Locality.	Length of Skull.	Per cent. of Breadth of Scapula.
	in.	
Vogelsand, Germany	148.2	33.3
Coast of Maine	135.0	33.2
Tay River, Scotland	125.0	32.8
Greenland (Lund Museum)	121.2	31.6
West Indies	114.5	31.2
Cape Cod, Mass. (21942)	113.0	31.8
Provincetown, Mass. (16252)	91.0	30.7

We find here, beautifully brought out, a gradual increase in the relative breadth of the scapula, with the increase in the size of the skull. Unless the series represented one species, it is hardly likely that this gradation would be obtained.

The scapulæ of the types of *M. bellicosa* and *M. osphyia*, like that of the Tay River (Scotland) whale, show a low, blunt spine, a very narrow prescapular fossa, and a slight elevation on the anterior border (pl. 34, fig. 4; pl. 36, fig. 3). The anterior border is nearly straight, though somewhat irregular in the upper three quarters, while the posterior border is evenly concave. A rudimentary coracoid is discernible in the United States specimens, as in the Tay River (Scotland) whale, and in the Greenland skeleton No. 269 in the Brussels Museum.

RADIUS AND ULNA.

Struthers has published a figure (*87*, fig. 6) of the forearm of the Tay River whale, which shows well the shortness and strong curvature of the ulna and the expansion of the radius at the distal end, but hardly gives the impression of massiveness which these bones have. Malm published a figure (after a photograph) of the radius of a specimen in the Stockholm Royal Museum, received from St. Bartholomew Id., West Indies, where it was collected by Dr. Goës (*66*, fig. 4a).

This last is comparable with the radius of the type of *M. bellicosa*, which was also from the West Indies, and probably from St. Bartholomew Id., and was collected by Dr. Goës (see p. 97). The two radii are exactly alike, except that the Stockholm specimen appears to be a little narrower at the proximal end.

The proportion of the breadth of the radius at the distal end to its length in various American and European specimens of *Megaptera* is as follows:

Type of *M. bellicosa* (Phila. Mus.)	41.1 %
St. Bartholomew Island (Stockholm Mus.)	41.0 %[1]
Type of *M. longimana* (Berlin Mus.)	40.9 %[2]
Greenland (Copenhagen Mus.)	40.3 %
Greenland ? (Brussels Mus.)	38.7 %[2]
Type of *M. osphyia* (Niagara Mus.)	38.2 %
Tay River, Scotland (Dundee Mus.)	35.8 %[2]

[1] The measurements of this radius given by Malm (*66*, 38) make the breadth at the distal end only 33 % of the length, but it is obvious by examination of the figure that the measurements are incorrect. The above proportion is from the figure, which is after a photographic original.

[2] From the figure.

FIG. 73.

FIG. 74.

FIG. 75.

FIG. 76.

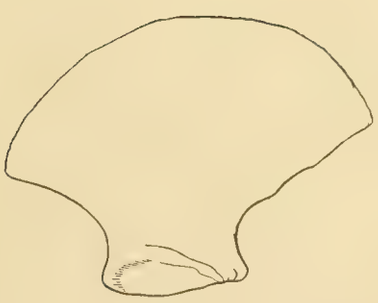


FIG. 77.

FIG. 78.

MEGAPTERA NODOSA (BONNATERRE). AMERICAN AND EUROPEAN. SCAPULA.

FIG. 73.—GREENLAND. AD. (FROM VAN BENEDEN AND GERVAIS.) FIG. 74.—TAY RIVER, SCOTLAND. ♂. (FROM STRUTHERS.) FIG. 75.—CAPE COD, MASS. (FROM A PHOTO.) FIG. 76.—PROVINCETOWN, MASS. IM. ♀. (FROM A PHOTO.) FIG. 77.—TYPE OF *M. OSPHYIA*. (FROM A PHOTO. OBLIQUE VIEW.) FIG. 78.—TYPE OF *M. BELLICOSA*. (FROM A PHOTO.)

The proportion for the Tay River whale is from Struthers's figure (*89*, fig. 6). His measurements give only 32.7 %. The cause of this discrepancy is not obvious. All the other specimens show a close agreement.

The correspondence in the bones of the forearm between the types of *M. osphyia* and *M. bellicosa* are seen on comparing plate 34, fig. 4, and plate 36, fig. 3.

The proportion of the length of the radius and ulna to the length of the skull in various American and European specimens is shown in the following table:

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. RADIUS AND ULNA.

Locality.	Length of Skull.	Length of Radius.		Length of Ulna.	
		With Epiphyses.	Without Epiphyses.	With Epiphyses.	Without Epiphyses.
	inches.	per cent.	per cent.	per cent.	per cent.
Vogelsand, Germany	148.2	23.7 [1]	....	....	....
Tay River, Scotland	125.0	28.8	26.0	24.0	22.0
Provincetown, Mass.	91.0	29.7	28.8	25.5	24.7
Cape Cod, Mass	113.0	28.8	26.1	24.4	22.7
Coast of Maine [2]	135.0	25.6	24.3	....	21.1
West Indies [3]	114.5	....	25.8	21.9	21.0
Greenland (Lund Mus.)	121.2	....	25.2	....	21.4

PHALANGES.

The number of ossified phalanges (exclusive of metacarpals) in the European Humpback has been given by Struthers (*87*, 38), and of the Greenland Humpback by Eschricht (*37*), Van Beneden (*8*, 134), and others, as follows:

MEGAPTERA NODOSA (BONNATERRE). EUROPEAN AND AMERICAN. PHALANGES.

Locality.	Author.	I.	II.	III.	IV.	V.
Vogelsand, Germany	Rudolphi		2	8	6	3 [4]
Tay River, Scotland	Struthers		2	7	6	3
Greenland	Van Beneden and Gervais		2	7	7 [5]	3
Greenland	Eschricht		2	7	7	2 [6]

[1] From Rudolphi's figure—Type of *M. longimana*.

[2] Type of *M. osphyia*.

[3] Type of *M. bellicosa*.

[4] In d'Alton's Die Skelete der Cetaceen, 1827, pl. 3, fig. e, the hand of a Humpback whale, which from the text appears to be the type of *B. longimana*, is represented with the following phalangeal formula: 2, 7, 6, 2.

[5] According to my own notes on this skeleton, there are 6 phalanges in the 4th digit.

[6] In a fœtus 45″ long. Eschricht's figure of a fœtus 35″ long, from Greenland, appears to show the following ossified phalanges: 2, 8, 8, 3 (*37*, 79). Eschricht also gives the formula for the adult as 3, 9, 9, 3, but does not state from what specimen or specimens this was derived (*37*, 141). It appears to include the metacarpals.

The phalanges are incomplete in the type of *M. osphyia*. They are arranged on each pectoral in three series, or digits, each digit having 3 phalanges, exclusive of the metacarpals. Each limb, therefore, has but 9 phalanges in all, showing that many are lacking. Some of the pieces mounted as metacarpals are probably phalanges.

The number of phalanges in the type of *M. bellicosa* is not given by Cope, and I was unable to find any considerable number of these bones, when examining the skeleton in the Philadelphia museum. Cope remarks that "the fore limbs are neither of them quite complete." (*29*.)

In the immature skeleton in the National Museum from Provincetown, Mass., (No. 16252 ♀) the formula for the left side is 2, 6, 6, 2.[1] In No. 21492, U. S. N. M., also from Cape Cod, Mass., the formula is 2, 7, 6, 1, as now mounted.

From the emarginations and tubercles on the anterior border of the pectorals in the Newfoundland specimens (pls. 37–40), both adult and fœtal, and in the

FIG. 79

FIG. 80.

FIG. 81.

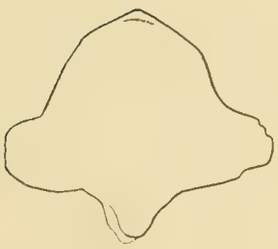


FIG. 82.

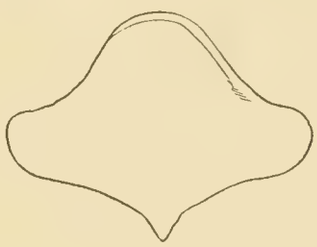


FIG. 83.

MEGAPTERA NODOSA (BONNATERRE). AMERICAN AND EUROPEAN. STERNUM.

FIG. 79.—ST. BARTHOLOMEW ID., WEST INDIES. (FROM MALM.) FIG. 80.—(FROM VAN BENEDEN. LOCALITY NOT GIVEN.) FIG. 81.—TAY RIVER, SCOTLAND. ♂. (FROM STRUTHERS.) FIG. 82.—ANTILLES. (FROM FISCHER.) FIG. 83.—TYPE OF *M. LONGIMANA*. (FROM PANDER AND D'ALTON.)

Cape Cod (Mass.) specimen (pl. 41, fig. 6), it is certain that the same number of phalanges may be counted for digit 2 in these specimens as in the Greenland Humpback and the European species, and for digit 3 the variation can hardly be more than one phalanx, with a probability that there is no difference.

[1] On the right side, the formula is actually 2, 5, 5, 2, but one phalanx has obviously been lost from digits 3 and 4, as the irons supporting the bones project a considerable distance beyond the last phalanges now in position. Mr. F. A. Lucas has kindly given the formula for the fresh specimen, as recorded by him at the time it originally passed through his hands. It is the same as above, viz., 2, 6, 6, 2.

The phalanges on digits 4 and 5 cannot, of course, be estimated in the same way, as they are not indicated on the posterior margin of the fin.

STERNUM.

The sternum has not been preserved in the American skeletons with which I am familiar. Fischer (*44*) has figured the sternum of a specimen from the Antilles, which should represent Cope's *M. bellicosa*, and Malm (*66*, pl. 1, fig. 4b) has also given a figure of a partially incomplete sternum from St. Bartholomew Island. These, with the sterna of two European specimens, are represented in the outlines (text figs. 79 to 83) on p. 239. They show that there is no essential difference in the pattern of the sternum in the American and European Humpbacks. From a systematic point of view the sternum is of little importance, on account of the large amount of individual variation to which it is subject.

RIBS.

The first rib in *Megaptera* is broad at the distal end. In the type of *M. bellicosa* it is cut off square (pl. 35, fig. 2), but in the Tay River whale, according to Struthers's description and figure, the distal end is emarginated, more strongly on the right side than on the left, forming an anterior and posterior angle.

The second rib in *M. bellicosa* has an oblong prolongation at the proximal end, with parallel margins, from the head to the angle. The second rib in the series of ribs from St. Bartholomew Island figured by Malm (*66*, pl. 1, fig. 4c) is club-like at the proximal end, without distinct processes, while the second rib in the Tay River whale "has a prominent tubercle, the end sloping obliquely downward and inward, giving a broad triangular beak." This is seen in the third rib of the type of *M. bellicosa*, but not in the second. In the Humpback described by Van Beneden and Gervais "the third, especially, and the fourth differ from the others by possessing a distinct head" (*8*).

It will be seen that no two skeletons agree in the shape of the ribs, and these parts therefore do not aid in the discrimination of species.

SUMMARY.

From the foregoing presentation of the recorded data relative to the external and osteological characters of the Humpbacks of the coast of Europe, Greenland, and the North American mainland, the following condensed statement may be drawn up:

1. The average and maximum lengths for the Humpbacks taken at the Finmark whaling stations, according to Cocks's measurements, are larger than the measurements of those taken at Newfoundland. On the other hand, Humpbacks from Bermuda and Greenland are cited as larger than the Finmark specimens.

2. The Humpbacks of both sides of the Atlantic have the same two colors—

black and white—and the amount and distribution of these colors are variable to the same extent in specimens from the eastern and western Atlantic.

3. The measurements of external proportions of the body and fins show a substantial agreement, except as regards the spread of the flukes, in which there is an unexplained variability.

4. The abdominal folds agree in number, size, and especially in arrangement.

5. The dermal tubercles on the head agree well in number, size, and general arrangement, though there is a large individual variation.

6. There is no constant difference in the shape of the dorsal fin between the American and European Humpbacks, unless it be that the tip is thicker in Greenland specimens.

7. The pectoral fin agrees in length, breadth, and especially in the protuberances of the margins.

8. The flukes are alike in form, with a possible difference in spread.

9. The outline of the caudal peduncle or "small" is alike in Newfoundland and Norwegian specimens.

10. The skeleton agrees closely in the number of vertebræ and the formula for the same; in the proportions of the skull and of the bones of the limbs. The Greenland Humpback, however, appears from Eschricht's figure to have smaller nasals than the others, and more deeply emarginated frontal orbital processes, but there is a strong presumption that the figure is inaccurate.

Considering the difficulties encountered in instituting exact comparisons between data recorded at different times by different observers, the agreement is sufficiently close to justify the opinion that the Humpback whales of the North Atlantic are all referable to the same species. In other words, the differences between the nominal species *M. nodosa*, *longimana*, *osphyia*, *bellicosa*, *americana*, etc., are not substantiated.

Although the type-skeleton of *M. osphyia* Cope, which in the foregoing pages has been currently treated as representing the common Humpback of the western North Atlantic, shows no differences which would render such treatment unwarranted, it seems to me desirable to consider a little further the differences by which Cope supposed it could be separated from *M. longimana*.

Cope compares his species with *M. longimana* as described in the works of Rudolphi, Gray, and Flower, and concludes that it is different for the following reasons:

1. *M. osphyia* has long inferior lateral processes in the posterior cervical vertebræ.

2. The atlas is a parallelopiped in form, the transverse processes are elevated, and there is an "internal process."

3. The cranium is broader in proportion to its length than in *M. longimana*, and shorter in proportion to the total length of the skeleton.

4. The pectoral fins are shorter.

5. The vertebræ and chevrons are less in number.

6. The first pair of ribs is very broad.

7. The spines of the lumbar vertebræ are much higher.

I have already shown that the 4th and 7th characters are fictitious, as advanced by Cope, and that the 1st is merely an individual variation.

The width of the cranium of the type of *M. osphyia* (3d character) as compared with the length, differs from that in the Scotch skulls carefully measured by Struthers by only 1.1 per cent., which in actual measurement amounts to only $1\frac{1}{2}$ inches. This is certainly not significant, and is within the limit of variation of different American specimens of the Humpback among themselves.

The number of vertebræ (5th character) in the type-skeleton as mounted is 48, probably to be distributed as follows: C. 7, D. 14, L. 10, Ca. 17 (+) = (48 +). The last vertebra present is 4 in. square, and according to Struthers's measurements of *M. longimana*, about 4 more caudals must have been present originally, making 52 for the whole column, which is the average for *M. longimana*. Of chevrons there are 7 in position in the type of *M. osphyia*, with places for perhaps 10 in all. Van Beneden and Gervais give 12 as the number for *M. longimana*, but it is to be remarked that Struthers's Tay River (Scotland) specimen had but 10 chevrons, and the skeleton in the National Museum (No. 16252) from Cape Cod, Mass., but 9, so that it would appear that the number is variable, and unreliable as a specific character.

In the type of *M. osphyia* the breadth of the first rib on the left side is 9 in., and on the right $7\frac{1}{4}$ in. In Struthers's Tay River specimen the right rib of the first pair has a maximum breadth of 8.6 in., and the left, 5.3 in. It is obvious that the breadth is so variable even on the two sides of the same skeleton that it is useless as a specific character, but in this instance, as the skull of Struthers's specimen is but 125 in. long, while that of *M. osphyia* is 135 in. long, the maximum breadth of the first ribs in the two skeletons is practically the same relatively, with a little increase in favor of the European specimens.

In 1868 Cope cited as an additional character of *M. osphyia* the contraction of the orbital process of the frontal at the distal extremity (*27*, 194). He remarks: "The orbital processes of the frontal bone are not contracted at the extremities as in *M. longimana*, but are more as in *Balænopteræ;* entire width over and within edge of orbit, $15\frac{1}{2}$ in." This measurement I make 14 in. instead of $15\frac{1}{2}$ in. The former equals 10.4 % of the length of the skull. As shown in the table on p. 233, the same measurement from Rudolphi's figure of the type of *M. longimana* is 9.0 %, and of Struthers's Tay River specimen 9.6 %, while the type of *M. bellicosa* gives 10.7 %. This approximation shows that *M. osphyia* presents no great deviation in the breadth of the supraorbital edge of the frontal. It is true that in Rudolphi's figure of the whole skeleton of the type of *M. longimana* the orbit itself appears smaller, but in a general figure of this kind the proportions of the smaller parts are frequently inaccurate. The least longitudinal diameter of the orbit in Struthers's Tay River whale is, according to his measurements, the same as in the types of *M. osphyia* and *M. bellicosa*. As it is extremely unlikely that the two European skeletons belong to different species, the probability that Rudolphi's figure is inaccurate as regards the orbit is strengthened by this circumstance.

The Humpback appears to have been known to European zoölogists only from

American sources, until the time of Rudolphi's description of *M. longimana* in 1832. This author suspected that his species might be the same as Fabricius's *boöps*, and Schlegel in 1844 was of the same opinion.

In 1848 Eschricht arrived at the same conclusion from an opposite point of view, and in 1849 stated emphatically: "It is now raised beyond all doubt that the whale stranded in the mouth of the Elbe River in 1824, and described by Rudolphi as *Balæna longimana*, is nothing more and nothing less than an individual of the commonest species of baleen whale on the Greenland coast, known to the Greenlanders as the *Keporkak;* also mentioned by Anderson under the latter name and introduced into systematic zoölogy by Klein and Bonnaterre under the appropriate name *Balæna nodosa*" (*37*, 57). As this latter name is derived from the description of the New England Humpback, Eschricht combines not only the Greenland and European Humpbacks but those of the coast of the United States as well, in one species. Gray, however, was not content to have it so, and already, in 1846, separated the "Bermuda Humpback" under the name of *Megaptera americana* (*56*). In 1866 he still adhered to this arrangement, employing the name *M. americana* as before and citing Fabricius's *Balæna boöps* with a mark of interrogation, under *M. longimana*, with the comment: "Rudolphi, and after him Schlegel, refer *B. boöps*, O. Fabricius, to this species; and Professor Eschricht has no doubt that *Balæna boöps* of O. Fabricius is intended for this species, as it is called *Keporkak* by the Greenlanders. If this be the case, Fabricius's description of the form and position of the dorsal fin and the position of the sexual organs is not correct" (*53*, 124), Gray seems not to have known at this time of Cope's description of *M. osphyia*, published in 1865. In the supplement to his catalogue he quotes Cope's description, but without comment.

In 1869, Van Beneden and Gervais remark as regards *osphyia* and *boöps* (= *longimana*): "We do not find any difference of value for separating them" (*8*, 236). and again in 1889 Van Beneden unites all the American Humpbacks in one species.

Fischer (*44*, 58), who studied the Humpback bones from Martinique Id. in the Bordeaux museum, which should presumably represent *M. bellicosa*, was unable to decide whether they should be assigned to the same species as the Greenland Humpback, and closes his investigation with the inquiry whether all the Humpbacks should not be regarded as belonging to a single species.

NOTE.—Two excellent illustrations of the Newfoundland Humpback, from negatives obtained by Mr. Wm. Palmer, of the U. S. National Museum, in 1903, are reproduced on plate 38, figs. 1 and 2. The individual represented in fig. 1 is unusually white and on that account especially interesting.

CHAPTER VIII.

THE NORTH ATLANTIC RIGHT WHALE, *BALÆNA GLACIALIS* BONNATERRE.

Since the separation of the Right whale of the temperate eastern Atlantic from the Arctic Right whale by Eschricht, the validity of the former species has been universally accepted, though opinions have differed as to whether its American counterpart is identical with it. The European species, known as the Nordcaper or Sarde, was named *Balæna glacialis* by Bonnaterre (*9*, 3) and *Balæna biscayensis* by Eschricht (1860). The latter name was not accompanied by a description. Bonnaterre's diagnosis does not include a reference to a type-specimen. Unless there is more than one species on the European coasts, we may, therefore, draw characters from whatever specimens have been described. As would naturally be expected, the later accounts are generally fuller and more accurate than the earlier ones, but even the fullest descriptions are to a certain extent fragmentary and unsystematic and contain contradictory statements and measurements. To thread one's way through the maze requires a large amount of patience and consumes a great deal of time, and the results obtained are not entirely satisfactory.

My study of the literature of the European Right whale, and of American specimens, leads me to believe that there is a greater amount of individual variation as regards proportions in the genus *Balæna* than in *Balænoptera*, and that we may not look for the same conformity in this respect in the former as in the latter. It is possible, of course, that there may be several species of *Balæna* on the European coasts and an equal number on the Atlantic coasts of North America, but there appears to be no real foundation for such an opinion. To a certain extent the variations in proportions observable among specimens hitherto described are, no doubt, due to differences in age and to inaccurate measurements. It will be found that in general appearance, color, form of parts, etc., the European specimens agree well together.

The European specimens which have been described are few indeed. The most celebrated is that captured at San Sebastian, Spain, in 1854. It was a young individual 24 ft. 9½ in. long. It enabled Eschricht to prove his assumption that the Right whale of the temperate eastern Atlantic was a different species from the Arctic Right whale. He intended to publish a detailed account of it, but died before the work was accomplished (Fischer, *44*, 19). Dr. Monedero in San Sebastian published a lithographic figure of this specimen, with measurements which have been copied by Fischer (*44*, 19), Gasco (*48*, 587), etc. This figure has been highly

praised, and often copied, but it hardly seems possible that the remarkably short head can be correct. The skeleton was very fully described by Gasco in 1879 (*48*).

Fischer, in 1881, reprinted the description and measurements (*44*, 10) published in 1682 by Segnette of a specimen stranded on Ré Id., France, in 1680.

In 1877, a specimen was stranded at Taranto, Italy, of which descriptions and figures were published by Capellini in 1877 (*13*) and by Gasco in 1878 (*47*). It is an unfortunate circumstance that Gasco's measurements do not agree with Capellini's; nor do they agree with the figures in the plates accompanying his memoir, nor do the figures agree with each other.

In 1889 Graells (*52*) published measurements and figures of a specimen captured at Guetaria, Spain, in 1878, and preserved in the museum of the Institute of Secondary Instruction at San Sebastian. In the same memoir are included additional facts regarding this specimen by Prof. Candido Rios y Rial (*52*, 63–67, sep.).

In 1893, Prof. Guldberg published a very valuable article entitled Zur Kenntniss des Nordkapers (*59*), containing measurements of specimens taken at Iceland, together with three photographic figures of the exterior, and figures of the pelvic bones and sternum.[1]

The foregoing memoirs contain practically all the data on the Nordcaper available for use in comparing European with American specimens.

SIZE.

The total length of the various recorded specimens of the European Nordcaper is as follows:

BALÆNA GLACIALIS BONNATERRE. EUROPEAN. TOTAL LENGTH.

Locality.	Date.	Sex.	Total Length.			Age.	Authority.
			English ft. and in.	Original Measure. Meters.	ft. and in.[3]		
Iceland	1891?	....	51′ 8″	.....	50′ R.[4]	....	Guldberg
Ré Island, France	1680	♀	50′ 7″	15.43	47½′ F.	..... [5]	Fischer
Soulac, France	1852	....	49′ 2½″?	15.0?	.....	.....	Van Beneden
Iceland	1891	♂	47′ 7″	14.5	46′ R.	.....	Guldberg
"	1891	♂	47′ 7″ ±	.....	46′ ± R.	.....	"
"	1890	....	46′ 7″ ±	.....	45′ ± R.	.....	"
"	1889	♀	43′ 3½″	13.2	42′ R.	.....	"
"	1891	....	43′ 3½″	.....	42′ R.	{ "Not entirely full-grown"	"
Taranto, Italy	1877	♀	39′ 4″	12.0	.....	adolescent.	Gasco
Guetaria, Spain	1878	...	34′ 3″[2]	10.46	.....	.....	Graells
Herbaudiere, France	1811	....	32′ 10″ ±	.....	28′ to 30′ F.	.....	Van Beneden
San Sebastian, Spain	1854	....	24′ 9½″	7.56	26′ 9″ S.	young	Gasco

[1] These figures on a larger scale were also published by Buchet in 1895 in *Mem. Soc. Zool., France*, 8, 1895, 229–231, pls. 6–8. They bear here the legend "Phot. de M. Berg"—In Guldberg's paper the legend is "Guldberg phot."

[2] Skeleton. Van Beneden cites this as 48 ft. long, which must be an error.

[3] F.= French measure; R.= Rheinland; S.= Spanish. I am not positive as to the Rheinland.

[4] In a straight line.

[5] Fischer states that this specimen was young, but there is no evidence that such was the case.

It will be observed from the table that the largest European specimen is the Iceland one cited by Guldberg, which was 51′ 8″ long in a straight line. Guldberg's statement regarding it is as follows: "Captain Berg told me that the largest specimen captured by him measured 50 feet [Rheinland ?] long (in a straight line) and 46 feet in maximum girth" (*59*, 15).[1]

The next largest was that recorded by Segnette as stranded on the island of Ré, France, in 1680. It was a female and its length was 50 ft. 7 in. Fischer asserts that this individual was young (*44*, 16), but there is no evidence that this was the case. He was influenced by the measurements given by Rondelet and Paré for the whale of the Basques. According to these early zoölogists, this whale reached a length of 36 cubits (*coudées*), or as Fischer has reckoned it, 23.4 m., or 76 ft. 9 in. There is no probability that the Nordcaper ever reached such dimensions.

The American specimens hitherto recorded present the following lengths:

Locality.	Date.	Sex.	Total Length.	Age.	Museum.	Authority.
Cape Lookout, N. C.	Mch. 20, 1894	♀	53′ 0″	Adult	.....	Brimley
Beaufort, N. C	1874	♂	50′ 0″ ± [Skeleton as mounted, 44′ 9″]	"	State Museum, Raleigh, N. C.	Brimley
Long Island, N. Y.....	.....	....	Skeleton 44′ 9″	.....	Field Col. Mus., Chicago	Elliot
Egg Harbor, N. J.....	Spring, 1882	♀[2]	48′ 0″	.....	Not preserved	Holder
Cape Lookout, N. C...	Feb. 15, 1898	♀	46′ 0″ est.	Adol. or ad.	Wis. Acad. Sci.	Brimley
Long Island, N. Y....	1888	....	Skeleton 45′ 3″[3]	Adol.	U. S. Nat. Mus., No. 23077	F. W. T.
Cape Cod, Mass.....	April, 1895	♂	42′ 5″	.....	.....	Blake
Charleston, S. C.....	Jan., 1880	♂	40′ 4″	Adol.	Charleston Col.	Manigault
Long Island, N. Y.....	18—?	...	Skeleton 35′ 0″ + est.	.....	Am. Mus. Nat. Hist., New York	Holder
Opposite Philadelphia[4].	1862	....	Skeleton 37′ 0″ est.	jr.	Acad. Nat. Sci., Philadelphia	Cope
Cape Lookout, N. C...	Mch. 20, 1894	....	30′ 0″ ±	"	Not preserved	Brimley

A comparison of the foregoing measurements of total length with those previously given for the European specimens shows that there is no considerable difference in size in individuals from the two sides of the Atlantic.

The largest American specimen, as above indicated, was 53 ft. long. The largest European specimen (Iceland) was 51 ft. 8 in. The younger specimens show a parallel gradation in size. It may be stated, therefore, that European and American specimens cannot be differentiated by size.

EXTERNAL PROPORTIONS.

The exterior measurements recorded by those who have had an opportunity to examine the Atlantic Right whale in a fresh condition are so meagre and so little conformable that they give but scant assistance in determining the questions at

[1] Guldberg's own measurements appear to be in Rheinland feet (12 in. Rheinl. = 12.357 English), but he cited one measurement from Capt. Berg in English feet, which may be the kind intended here, in which case the Ré Island specimen would be the longest one.

[2] See Holder (*36*, 112, 120).

[3] The length of the skeleton as mounted is probably too great, on account of the exaggeration of the caudal intervertebral spaces.

[4] Type of *Balæna cisarctica* Cope.

issue. Furthermore, the few measurements available for comparison show large discrepancies, as will be found upon examination of the following table:

BALÆNA GLACIALIS BONNATERRE. EUROPEAN AND AMERICAN.

	Ré Id., France, Feb., 1680. (Segnette, 1682.)	San Sebastian, Spain, 1853. (Copenhagen Mus.) (Fischer, 1871.)	East of Iceland, 1889. 65° 7′ N. 6°, 20″ W. (Guldberg, 1891).	Taranto, Italy, 1877. (Capellini, 1877.)	Ditto. (Gasco, 1878)	Charleston, S. C., 1880. (Manigault, Holder.)	Egg Harbor, N. J., 1882. (Holder, 1883).	Cape Lookout, N. C., 1894. (Brimley, 1894.)
Sex	♀	.....	♀	♀	♀	♂	♀	♀
Age	.....	jr	.....	.....	...	....	..	ad
Length of whale	47½′ [1]	26′ 9″ [1]	42′ 0″ [2]	39′ 4″	39′ 4″	40′ 4″	48′ 0″	53′ 0″
" " skeleton	.....	.....	.....	.....	....	35′ 7″	....	.....
	♀	♀	♀	♀	♂	♂	♀	♀
Tip of snout to eye	23.2	19 2	.....	.....	....	....	25.0	22.6 ±
" " " " pectoral	[27.4]	.....	.....	.....	....	25.5	....	.....
Length of pectoral	7.1 †	14 0	.....	15.4 [3]	15.4	16 3	14.6	.....
Breadth " "	8.4	9.3	.....	8.3	8.3	.. .	8.0	.....
Flukes from tip to tip	33.7	33.6	30.0	29.2	29.2	27.3	35.4	32.1
Girth in front of fore limbs	.....	.....	.....	.....	....	50.2	....	.....
Space between pectorals on abdomen	.....	.....	.....	.....	....	15.9	....	.....
Breadth of margin of mandible	.....	.....	.....	.....	....	....	1.4	....
From highest cranial eminence to orbit, axially	.....	... ..	.....	... .	....	....	19.4	.....
Ear above horizon of eye	.....	.....	.....	.....	....	....	1.2	.....
" from vertical axis of eye	.....	.....	.....	.....	....	....	2.8	.....
Eye to anterior face of axilla	4.3	.....	.....	.....	....	....	5.0	.....
Circumference of caudal terminus or "small"	.....	.....	.....	.....	....	....	13.9	.....
"Small" to caudal bifurcation	.....	.....	.....	.....	....	....	8.3	.....
Length of each fluke axially	.....	.....	.....	.....	19.2	....	20.8	.....
Breadth " " " "	.....	.....	.....	.....	9.3	....	8.2	7.9
Length of blowhole, axially	.....	.....	.....	.....	....	....	2.1	.....
Divergence of blowholes posteriorly	.....	.. ...	.....	.....	....	....	2.8	.....
Nasal prominence, width	.....	.....	.....	.....	....	....	2.8	.....
" " height	.....	.....	.....	.....	....	....	3.5	.....
Total circumference	56.9 to 58.3	65.1	.....	....	....	....	....	.....
Pectoral to pudendum	42.8	.....	.....	.....	....	....	....	.....
Length of "	6.3	.....	.....	.....	....	....	....	.....
Pudendum to extremity of tail	29.8	.....	.....	.....	....	....	....	.....
Height at level of blowholes	22.3	.....	.....	.....	....	....	....	.....
" of lower jaw at middle	.....	11.5	.....	.....	....	....	....	.....
Circumference at middle of body	.....	.....	.....	.....	52.5	....	....	.....
" " posterior third	.....	.....	.....	.....	29.2	....	....	.....
Longest whalebone	.....	.....	7.1	6.3 [4]	6.6	10.3	11.9	13.5

[1] French measure.

[2] Norwegian measure.

[3] To anterior insertion (see Gasco, pl. 9, fig. 2).

[4] Along inner curve.

The first point that arrests one's attention in comparing these measurements is that the distance from the tip of the snout to the eye in the San Sebastian (Spain) whale is very short. This has been insisted on in all the accounts of this whale and appears in Monedero's drawing, copied by Fischer (*44*, 18, fig. 1), Van Beneden and Gervais, and others. The appearance of the head in the figure is so peculiar as to lead one to think this young specimen was either abnormal, or that the drawing was inaccurate. Nothing is to be seen of this peculiarity in Guldberg's photographic figures of older individuals. The Ré Island (France), Egg Harbor (New Jersey), and Cape Lookout (North Carolina) specimens show a reasonable agreement as regards this measurement.

In the length and breadth of the pectoral limb the European and American specimens show a very close agreement, amounting to identity of proportions.

In the measurement of the flukes, on the contrary, the European specimens neither agree with each other nor with the American specimens, nor do the latter agree among themselves. In all species of whales the expansion of the flukes appears subject to a considerable amount of individual variation, but this would not account for the marked discrepancies observable in the foregoing table. As regards the Taranto (Italy) whale, it would appear that the measurement of the flukes from tip to tip is incorrect, because while this is much below that of most of the other specimens, the measurement of the length of one of the lobes of the flukes is only a trifle less than that of the American specimen having the widest spread flukes; in other words, the length of one lobe of the flukes is recorded as two thirds the distance from tip to tip, which is highly improbable.

The measurement for the Charleston (South Carolina) whale is still smaller, 27.3 % of the total length, while the Egg Harbor (New Jersey) whale has the maximum proportion of 35.4 %. There appears to be no way in which to reconcile these differences.

The length of the whalebone in the European and American specimens differs considerably. In the Taranto whale it was but 6.6 % of the total length of the whale, and in Guldberg's Iceland specimen of 1889, 7.1 %. In the Charleston whale, which was 3 feet shorter than the last mentioned, the whalebone was 10.3 %. The various absolute measurements are as follows:

BALÆNA GLACIALIS BONNATERRE. EUROPEAN AND AMERICAN. WHALEBONE.

Locality.	Sex.	Length of Whale.	Length of Whalebone.
		ft. in.	ft. in.
Charleston, South Carolina	♂	40 4	4 2
Cape Cod, Mass	*	42 5	5 6
Egg Harbor, New Jersey	♀	48 0	5 9
Cape Lookout, North Carolina, 1874	♂	53 0	7 2
" " 1898	♀	46 0 est.	6 4
Taranto, Italy	♂	39 4	2 7½
Iceland	♀	43 3½	3 1
(Guldberg's longest Iceland whalebone)	..	.....	6 5½
(Berg's longest Iceland whalebone)	..	.....	7 4

It will be observed that while in the young European specimens the proportional length of the whalebone falls below that of the American specimens, nevertheless, the largest Iceland whalebone equals or exceeds that of the largest American specimen. While the discrepancies above mentioned are not explainable at present, it appears that adult European and American specimens have whalebone of equal length.

Although the largest whalebone cited in the preceding table is only 7 ft. 4 in. long, various writers on the Colonial Right whale fishery mention lengths for this species of 8 feet and 9 feet. This might be regarded an exaggeration, but there are slabs of whalebone from the Pacific Right whale in the National Museum which measure 8 ft. 2 in. and 8 ft. 6 in., respectively, and the whalebone of the Atlantic species may have formerly reached that length in some cases.

COLOR.

The Atlantic Right whale known to American whalers was called by them the Black whale, in allusion to its color. In the European Nordcaper the body in all recorded cases was black. The young San Sebastian whale, judged by the copy of Monedero's drawing given by Graells (*52*, pl. 1, fig. 2) appears to have been uniform black. The Taranto whale, according to Gasco (*47*, 14), was also uniform black, as was Segnette's specimen of 1680. Regarding the Iceland whales, Guldberg remarks as follows (*59*, 16):

"The color of the skin is, as already known, deep black, sometimes with a tinge of blue (*einem Stich ins Blaue*). This deep black color is spread over the whole body. On this account, I was surprised that Capt. Larsen remarked that the young example caught by him was of a lighter color on the belly. This statement was, however, in part at least confirmed by the fragments of skin sent me, as many of these showed white epidermis layers (*Oberhautpartien*), which were sharply contrasted from the black dermis layers (*Hautpartien*) on the same pieces. In the pieces of skin preserved in alcohol, the unpigmented epidermis layers were yellowish-white, and the boundaries very sharply defined from the deep black pigmented parts. By inquiry among the sailors and others, who had seen the freshly caught Nordcaper, as well as by direct communication by letter with Capt. Berg, it was, however, established that only single white spots appeared here and there on the otherwise black body. The white spots were found on the extreme tip and surface of the pectorals, on the tip of the flukes as well as in the 'bonnet' on the snout,—all places infested by parasites. The spots are small and can hardly be found in all examples.

"In the specimen figured (*59*, pl. 1), judging from the photograph, white spots appear to occur around the genitals, but I can not affirm this with certainty."

The foregoing statements seem to confirm the idea that the European Nordcaper is normally black throughout. The white spots appear to be due to the alteration of the skin produced by parasitic cirripeds, as in the Humpback. The yellowish-white spots in the alcoholic specimens of skin might be attributed to a separation of the epidermis, and accumulation of air or alcohol below.

Among the American specimens, we find that the Charleston whale was entirely black. The Egg Harbor, New Jersey, whale was also black.

The Cape Lookout specimen, captured March 20, 1894, a female, was said to be a "white-bellied" one. The figure published in the *Bulletin of the North Carolina Dept. of Agriculture* (14, No. 7, April, 1894, p. 4) shows the whole under surface light colored, from a point in advance of the eye to the anus, the white area extending up to the base of the pectorals and having irregular margins. If the drawing was correctly made from the specimen itself, it indicates a remarkable color variation. In a letter Mr. H. H. Brimley remarks that this specimen had "a great deal of pure white on its under side."

The foregoing facts may be summed up as follows:

Three specimens of the European Nordcaper are recorded as being entirely black, and the Iceland specimens were also black, with the exception of one young one, which was reported to be lighter colored on the belly. Of three American specimens, two are recorded as entirely black, and one (adult female) as having "a great deal of pure white on its under side." (See pl. 46, figs. 1 and 2.)

OSTEOLOGICAL CHARACTERS—NUMBER OF VERTEBRÆ.

The skeleton of the European Nordcaper has been described in detail and figured by Gasco (*47* and *48*), Graells (*52*), Capellini (*13*), and Guldberg (*59*). The skeleton of American specimens has been described and illustrated by Holder (*61*) and Manigault (*68*). (See pls. 42–46.)

The number of vertebræ has been given by these authors for several individuals, as follows:

BALÆNA GLACIALIS BONNATERRE. EUROPEAN. VERTEBRAL FORMULA.

Locality.	Sex.	Age.	Author.	C.	D.	L.	Ca.	Total.
Taranto, Italy	♀	Adoles.	Gasco	7	14	12	23	56
" "	♀	"	Capellini	7	14	—3	6—	57
San Sebastian, Spain	..	jr.	Gasco	7	13[1]	13	23	56
Iceland (I)	..	.....	Guldberg	7	14	12	21 (+3)	54 (+3)
" (II)	..	.....	"	7	14	—3	5—	56
" (III)	..	.....	"	7	14	—3	5—	56
(Guldberg's formula for the species)	..	.....	.....	7	14	12	23	56

BALÆNA GLACIALIS BONNATERRE. AMERICAN. VERTEBRAL FORMULA.

Locality.	Sex.	Age.	C.	D.	L.	Ca.	Total.
Long Island, N. Y. (I)[2]	..	..	7	14	10	26	57
" " " (II)[3]	..	..	7	14	11[4]	20+	52+[5]
New Jersey[6]	..	jr.	7	14	11	24	56
Charleston, S. C.	♂	jr.	7	14	11	23	55
Cape Lookout, N. C., 1874	♂	ad.	7	14	11[7]	22+	54+
Provincetown, Cape Cod, Mass.[8]	..	..	7	14	11	24	56
Long Island, N. Y. (III)[9]	..	..	7	14	11	25	57

[1] Gasco gives 13 pairs of ribs, but thinks there may have been 14 pairs. Hence, the formula was perhaps 7, 14, 12 (or 11), 23 (or 24) = 56. [2] U. S. National Museum, No. 23077, [3] Amer. Mus. Nat. History. [5] Holder states that the total is "probably 57." [7] Or 12. [4] Possibly only 10 lumbars. [6] Type of *B. cisarctica*. [8] Mus. Comp. Zoölogy. [9] Field Col. Mus., Chicago.

It will be observed from these tables that the number of dorsals in both European and American specimens is uniformly 14, the only exception being in the San Sebastian (Spain) skeleton. In this case, however, Gasco thinks there may have been 14 pairs of ribs.

The number of lumbars is fixed by the position of the first chevron. As the series of chevrons is commonly incomplete in museum specimens, and, furthermore, as the transition from the quite sharp inferior carina of the lumbar vertebræ to the paired inferior ridges of the caudals is not always abrupt, it is extremely difficult in many cases to determine correctly the number of lumbars. The widening of the posterior end of the inferior carina may be more or less distinctly marked on the 32d vertebra, in which case there might be considered to be 10 lumbars. On the other hand, this thickening of the carina may not be pronounced until the 34th vertebra is reached, in which case, 12 lumbars might be counted.

My own observations on American specimens lead me to believe that 11 lumbars may be regarded as the normal number, varying from 10 to 12. Guldberg and Gasco, however, regard 12 lumbars as the normal number for European specimens.

The Guetaria (Spain) skeleton of 1878 appears from Graells's figure (*52*, pl. 3) to have but 8 lumbar vertebræ and about 26 caudals. I am unable to account for this discrepancy and Prof. Rios y Rial's description (*52*, 65–67) is unintelligible to me on account of the manner in which he divides the vertebral column.

It would be possible to reduce the number of lumbar vertebræ to 8 in the Long Island (N. Y.) skeleton in the National Museum, No. 23077, if the first caudal were regarded as that in which a thickening of the posterior end of the inferior median carina first occurs. It is obvious that the question of the real number of lumbars in the species cannot be authoritatively settled until the chevron bones are examined *in situ* in a number of adult and fœtal specimens. Gervais's views regarding the number of lumbars in the Sulphurbottom whale are of interest in this connection. (See p. 182.)

SKULL.

The best figures of the skull of the European Nordcaper are those of Gasco (*47*, pls. 2–4) and Graells (*52*, pls. 3–4). While these agree in most particulars, they show a considerable divergence at certain points. The most striking difference is in the direction of the orbital processes of the frontal. In Gasco's figure these processes lie entirely behind the line of the antero-superior end of the occipital, and are directed backward, while in Graells's figure the greater part of the frontal processes lies in front of the line of the occipital, and the processes are directed forward. This relation of the bones is shown especially in *52*, pl. 4, fig. 2, but also in pl. 4, fig. 1, and in pl. 3, fig. 2. In the latter, which is a figure of the entire skeleton, the skull appears to be a reduced copy of pl. 4, fig. 2. In pl. 3, fig. 1, which is a view of the entire skeleton from the side, the orbital process of the frontal is represented more as if directed backward rather than forward, thus

agreeing better with Gasco's figures. Another important difference in Graells's figures, as compared with those of Gasco, is that the anterior ends of the premaxillæ are represented as narrow and acuminate. Graells's figures are reproductions of drawings by Sr. Janer, while in Gasco's figures the outlines are taken from photographs, "to avoid inexactness." This latter may, therefore, be considered the more reliable.

Gasco's figures (*47*, pl. 2, figs. 1 and 2; pl. 3, fig. 1) of the Taranto (Italy) whale show a very close agreement with the skull of the specimen from Long Island (New York) in the National Museum, No. 23077, pls. 42 and 43. The figures of the under surface of the skull especially (allowance being made for the slightly different point of view) show a very complete agreement. No one on comparing these several figures can, I think, fail to be convinced that they represent one and the same species. This is a matter of great importance, because, as will be pointed out presently, the measurements of the American and the European skulls vary considerably among themselves. The causes of this variation will be considered later.

I personally compared the skull of the Long Island (N. Y.) specimen in the American Museum of Natural History, New York, with photographs of the Long Island skull in the National Museum, No. 23077, and was unable to discover any differences of importance. In Holder's figure of the former (*61*, pl. 12) the superior outline of the rostrum does not descend rapidly enough anteriorly, due perhaps to the intermaxillæ not being represented as thick at the middle as they really are. In most other respects the figure is a good representation of the skull.

In one character Gasco's figure of the Taranto (Italy) skull differs from the American skulls I have examined. The premaxillæ extend so far back as to prevent the union of the maxillæ with the median anterior prolongation of the frontal at the vertex. In the American skulls in the Washington, Philadelphia, and Raleigh museums the premaxillæ are shorter posteriorly and the maxillæ project inward toward the median line along the sides of the nasal process of the frontal. This may, I think, be regarded rather as an individual variation than as a character of specific importance. In Graells's figure (*52*, pl. 4, fig. 2) the relation of the parts, as represented, agrees with the American skulls above mentioned.

The general shape of the nasals in the Taranto (Italy) and Guetaria (Spain) skulls is the same as in the Long Island (N. Y.) skull in the National Museum, No. 23077, except that there is a difference in proportions in the case of the Taranto specimen, as represented in Gasco's figure (*47*, pl. 4, fig. 9). Indeed, the nasals appear to differ in proportions in all the specimens, no two being exactly alike. In the type of *B. cisarctica* the nasals have the same emargination of the distal free border as in other American and European specimens, as shown in text fig. 84. The convex exterior border is in part overlaid by the intermaxilla when the nasal is in position, so that the latter then appears rectilinear in outline, as in other specimens. The variation in length and breadth in the different specimens is in part due to the unequal development of the median portion of the frontal against which the nasals rest.

FIG. 84.

The proportions of the various American and European skulls are indicated by the measurements given in the following table:

BALÆNA GLACIALIS BONNATERRE. EUROPEAN AND AMERICAN. SKULL.

	Iceland, 1891. Capt. Berg, III. (Guldberg, 1894.)	Iceland, 1891. Capt. Berg, I. (Guldberg, 1894.)	Iceland, 1890. Capt. Amlie. (Guldberg, 1894.)	Iceland, 1891. Capt. Berg, II. (Guldberg, 1894.)	Guetaria, Spain. Feb. 9, 1878. (Graells, 1889.)	Taranto, Italy. Feb. 9, 1877. (Gasco, 1878.)	Ditto from Gasco's top and side figures.	Ditto from under view and enlarged view of nasals.	Ditto. (Capellini, 1877.)	S. Sebastian, Spain. Jan. 17, 1854. (Gasco, 1879.)
Sex and age	♂	♂				♀ im.	♀	♀	♀	jr.
Total length of whale	47′ 7″ ±	47′ 7″	46′ 4″ ±	42′ ±	34′ 3″	39′ 4″	.....	.....	.....	24′10″
" " " skeleton	.....	.....	.....	.....	.....	37′ 9″	.....	.....	.....	.....
Length of skull (straight)	154.3″	153.9″	150.7″	133.0″	113.4″	89.3″	87.1″	90.0″	[6]	63.0″
	%	%	%	%	%	%	%	%	%	%
Greatest breadth at orbits	65.1	62.9	65.3	63.6	69.7	72.2	70.7	68.9	.....	64.4
Length of rostrum (straight)	.....	79.2	75.7[1]	74.9[1]	.....	.....	68.2[4]	.....	.....	.....
Breadth of rostrum at middle	.....	.....	.....	.....	.....	.....	12.2[5]	10.6[5]	.....	.....
Length of nasals	.....	.....	9.2	.....	6.7[2]	8.9	9.0	8.1	7.9	7.5
Breadth of 2 nasals distally	.....	.....	7.3	.....	7.7[2]	8.9	9.7	9.4	9.2	8.7
" " orbit, point to point	.....	.....	.....	.....	6.7[3]	.....	.....	.....	.....	.....
Length of mandible (straight)	97.5	98.5	.....	94.3	100.0	97.0	98.5	.....	102.2	88.1[7]
" " " (on curve)	102.5	101.0	.....	102.9	102.5[2]	110.1	.....	.....	110.1	92.2[7]
Depth " " at middle	.....	.....	.....	.....	7.1[2]	7.5±	.....	.....	.....	.....
End of nasals to end of rostrum (on curve)	.....	.....	.....	.....	82.5[2]	78.0	55.8[5]	.....	.....	66.2

	Cape Lookout, N. C. 1874. (Raleigh Mus.)	Long Island, N. Y. (Field Col. Mus.)	Long Island, N. Y. (Amer. Mus. Nat. Hist.)	Amagansett, Long Island, N. Y. (23077, U. S. N. M.)	Charleston, S. C. Jan. 7, 1880. (Charl. Coll. Mus.)	Coast of New Jersey. Type *B. cisarctica*. (Phila. Acad. Nat. Sci.)
Sex and age	♂ ad.	..	..	..	♂[9]	jr.
Total length of whale	50′0″ ±	.....	.....	.....	40′ 4″	.....
" " " skeleton	44′ 9″	44′ 9″	37′0″ +	45′ 3″[8]	35′ 7″[9]	37′ 0″
Length of skull (straight)	152.0	150.0″	128.0″	124.0″	114.5″	96.5″
	%	%	%	%	%	%
Greatest breadth at orbits	66.1	62.0	66.0	68.5	64.6	68.1
Length of rostrum (straight)	80.9	79.0	76.6	78.2	81.3	78.8[10]
Breadth of rostrum at middle	.....	9.3	14.1	.....	.....	.....
Length of nasals	5.1	7.8	7.3	7.3	7.4	8.3
Breadth of 2 nasals distally	6.6	11.0	7.2	6.5	8.3	7.8[11]
" " orbit, point to point	5.4	4.8	5.8	106.0	5.7	6.4
Length of mandible (straight)	90.1	98.0	96.8	110.5	93.4	95.4
" " " (on curve)	100.0	107.0	108.6	5.3	101.3	105.7
Depth " " at middle	7.2	7.3	6.6	8.5	6.8	7.2
End of nasals to end of rostrum (on curve)	76.6	71.4	78.9	83.8	80.0	.....

[1] From "hind angle," *i. e.*, base of rostrum; hence smaller. [2] From figure. [3] Least, from figure.
[4] On comparing Gasco's figures it will be seen that the rostrum in the top view is much too short. [5] Straight.
[6] Total length given only approximately by Capellini; hence taken from Gasco, 2.27 m.
[7] "From point of meeting of internal lateral margin with inferior margin of the condyle"; hence, a smaller per cent.
[8] Caudals spaced too much. [9] From Manigault. [10] Least. [11] Twice ½.

There is, as already stated, considerable variation, the cause of which is not entirely clear. This variation affects the American specimens, which I have endeavored to measure in a uniform manner, nearly as much as the European specimens, the measurements of which are collected from various sources.

The measurements of the Taranto (Italy) whale given by Gasco in the text of his article (*47*) do not agree with measurements taken from his figures, and measurements from the different figures do not agree with one another. Furthermore, Capellini's measurements of the same specimen do not altogether agree with Gasco's. Guldberg's measurements of the Iceland skulls also lack conformity to a considerable degree. While these differences may be partially due to different methods of measurement, it can hardly be supposed that they all arise in that way. This explanation does not serve in the case of my own measurements.

It seems probable that the discrepancies are in part due to the shrinking and warping of the various bones of the skull. The long, slender maxillæ and premaxillæ, the long orbital processes of the frontals and maxillæ, seem quite easily subject to such distortion, and in some skulls it can readily be seen that warping has taken place. Again, it should be observed that most of the skulls are those of young individuals, and probably exhibit differences of proportions correlated with different stages of growth. Aside from all this, however, it is undoubtedly true that the species shows a considerable individual variation in proportions.

The measurements of the length of rostrum in Guldberg's skull, received from Capt. Amlie, and in Capt. Berg's No. 2, are from the base of the same and not from the posterior margin of the maxilla, as in other cases. This accounts for the diminished length. The measurement of the rostrum of the Taranto whale was taken from Gasco's figure of the upper surface of the skull (*47*, pl. 2, fig. 1); but it is obvious on comparing this figure with the side view that the rostrum is too short in the former. A measurement from the side view gives about 77.2 % for the length of the rostrum, which is no doubt more nearly correct.

Gasco's measurements of the mandible of the San Sebastian whale of 1854 are "from the point of meeting of the internal lateral margin with the inferior margin of the condyle," which accounts in part at least for the much smaller proportion.

The other discrepancies, affecting the breadth of the skull across the orbits, the length of the mandible, and the distance along the curve of the premaxillæ, from the tip of the nasals to the tip of the premaxillæ, cannot be so readily explained. As they occur in both the American and the European series, however, they cannot be regarded as indicating specific differences. Doubtless, many of them would disappear if the various specimens could be brought together for actual comparison.

CHARACTERS OF THE VERTEBRÆ.

Measurements of the vertebræ and other parts of the skeleton in a few European and American specimens are given in the following table:

BALÆNA GLACIALIS BONNATERRE. EUROPEAN AND AMERICAN. SKELETON.

	Iceland, 1891. Capt. Berg, III. (Guldberg, 1894.)	Iceland, 1891. Capt. Berg, I. (Guldberg, 1894.)	Guetaria, Spain. Feb. 9, 1878. (Graells, 1889.)	Taranto, Italy. Feb. 9, 1877. (Gasco, 1878.)	S. Sebastian, Spain. Jan. 17, 1854. (Gasco, 1879.)	Cape Lookout, N. C.; 1874 (Raleigh Mus.)	Long Island, N. Y. (Field Col. Mus.)	Long Island, N. Y. (Amer. Mus. Nat. Hist.)	Amagansett, N. Y. (23077, U. S. N. M.)	Charleston, S. C. Jan. 7, 1880. (Charl. Coll. Mus.)	Coast of New Jersey. Type *B. cisarctica*. (Phila. Acad. Nat. Sci.)
Sex and age	♂	♂	..	♀ im.	jr.	♂ ad.	..	..	..	♂ [8]	jr.
Total length of whale	47′ 7″ ±	47′ 7″	34′ 3″	39′ 4″	24′ 10″	50′ 0″ ±	.....	.....	.....	40′ 4″	.....
" " " skeleton	.....	.....	.....	37′ 9″	.....	44′ 9″	44′ 9″	37′ 0″ +	45′ 3″ [6]	35′ 7″ [8]	37′ 0″
Length of skull (straight)	154.3″	153.9″	113.4″	89.3″	63.0″	152.0″	150.0″	128.0″	124.0″	114.5″	96.5″
	%	%	%	%	%	%	%	%	%	%	%
Greatest breadth of atlas	.....	.....	21.0 [1]	21.1	23.8	18.4	17.8	18.8	19.0	16.6	18.8
" " 1st dorsal	.....	.....	20.3 [1]	17.2	.....	17.8	16.3	16.4	16.1	15.8	18.1
Depth of centrum " "	.....	.....	.....	8.8	.....	6.0 [4]	5.8	6.6	.....	7.0	8.0
Greatest breadth, 1st lumbar	.....	.....	27.7 [1]	26.8	.....	24.3	26.0	25.0	27.0	26.2 [9]	26.6
Depth of centrum " "	.....	.....	.....	7.7 [2]	.....	5.6 [4]	5.8 [4]	6.3 [4]	7.7 [7]	6.1	7.1
Greatest breadth, 1st caudal	.....	.....	25.2 [1]	.....	.....	.....	21.5	20.3	19.4	20.1	22.3 [10]
Depth of centrum, " "	.....	.....	.....	10.1 [5]	.....	7.0 [4]	7.7 [4]	8.2	9.3	8.7 [4]	8.9 [4]
Greatest length of sternum	.....	.....	.....	.....	.. ...	7.3	9.3	.....	.....	.....	.....
" breadth "	.....	.....	.....	.....	.....	9.9	8.3	... . .	.....	.....	.....
Greatest breadth of scapula	31.9	31.3	28.9	30.9	30.6	.....	28.2	28.1	30.2	31.4	30.4
" depth "	26.0	27.6	22.2	24.2	23.1	.....	22.7	22.7	23.4	21.4	23.3
Length of radius	.....	.....	15.3	16.3	.....	12.2	12.0	14.1 [5]	13.7 [6]	15.3 [5]	15.2 [5]
" " ulna	.....	.....	12.9	13.2	.....	11.9	13.8	12.1 [5]	12.1 [6]	13.1 [5]	13.7 [5]

Gasco has given figures of many of the vertebræ of the Taranto (Italy) skeleton (*47*, pls. 3, 5, 7, 8), in which the outlines are taken from photographs. These figures I have compared with the Long Island (N. Y.) skeleton in the National Museum, No. 23077, and find a most complete agreement, except in one or two cases. In the figure of the 4th lumbar of the Taranto skeleton (vertebra No. 24) the anterior zygopophysis is much smaller than in the Long Island skeleton, and the posterior margin of the base of the neural arch is much more curved. In the side view of the 1st lumbar of the Taranto whale (vertebra No. 21) the transverse process is represented as having a peculiar shape and direction which is not evident in the front view of the same vertebra, and is not found in the Long Island skeleton. The sixth caudal (vert. No. 39) of the Taranto skeleton is represented as having only a shallow emargination inferiorly, while in the Long Island and other specimens the emargination is very deep and the anterior and posterior margins come close together, foreshadowing the formation of the foramen which is found in the posterior caudals. There is every probability that this figure is incorrect, or that the vertebra is imperfect below. All the vertebræ of the Taranto skeleton are figured without the epiphyses, and hence appear thinner than they otherwise would.

[1] From figure.
[2] 14th dorsal.
[3] Probably 2d caudal.
[4] Anterior.
[5] With proximal epiphysis.
[6] Caudals too much spaced.
[7] Posterior.
[8] From Manigault.
[9] Vertebra No. 22.
[10] Twice ½.

The points in the vertebral column at which the several processes and foramina appear or disappear furnish data of considerable importance in the comparison of species. These data are brought together in the following table:

BALÆNA GLACIALIS BONNATERRE. AMERICAN AND EUROPEAN. VERTEBRAL CHARACTERS.

	Long Id., N. Y. (No. 23077, U. S. N. M.)	Long Id., N. Y. (Amer. Mus. Nat. Hist.)	Cape Lookout, N. C. (Raleigh Mus.)	Charleston, S. C. (Charl. Coll. Mus.)	Cape Cod, Mass. (Comp. Zoöl. Mus.)	Coast of New Jersey. Type, *B. cisarctica*. (Phila. Acad. Nat. Sci.)	Long Id., N. Y. (Field Col. Mus.)	San Sebastian, Spain, 1854. (Copenhagen Mus.)	Taranto, Italy. (Naples Mus.)	Guetaria, Spain. 1898. (San Sebastian Mus.)
First vertebra with perforated transverse process, No.	36[1]	38	39	38	38	38	36[2]	.....	38	37
Transverse processes end on vertebra No.	40	41	42	43	.....	41	42	?	41[3]	41?
Neural spine ends on vertebra No.	43	45	46	45	44	45	45	44	44	43

It is much to be regretted that so few data relative to European specimens have been recorded. In so far as they are available for comparison, the agreement with corresponding data from American specimens is very close.

CHEVRON BONES.

The chevron bones are figured or described in the case of one or two European skeletons only. Graells's figure of the Guetaria skeleton (*52*) shows 12 chevrons, the first smaller than the second and somewhat pointed. Gasco states that the Taranto skeleton has 10 chevrons, but that some were probably lost.

Of the American skeletons, those in the Field Columbian Museum and in the Museum of Comparative Zoölogy, have 9 chevrons each. In both cases the first is attached to the posterior end of what is really the second caudal vertebra, so that the skeletons appear to have one more lumbar vertebra than they should. In the skeleton in the former museum the first chevron in position is small, but in the skeleton in Cambridge it is the largest of the series. In this case it is therefore probably the second chevron. The Charleston skeleton has 10 chevrons, but there were probably more originally.

RIBS.

The number of pairs of ribs is 14 in all European and American specimens, except the San Sebastian skeleton of 1854, and in this also, although 13 pairs are

[1] Right side only. [2] Left side only. [3] Or 42d.

assigned to it by Gasco, he expresses the opinion that there may originally have been 14 pairs.

In the majority of specimens the first rib is single-headed, but in the Guetaria (Spain) skeleton, that of the right side shows a small secondary process adjacent to the proximal end. The bifurcation is also found in the San Sebastian skeleton of 1854. Gasco's description of the first pair of ribs in this specimen is as follows:

"No doubt the first pair of ribs of the young whale of San Sebastian, placed opposite the corresponding parts of the Taranto whale, exhibit certain singular differences, which though they do not surprise us at present, led J. E. Gray to create the genus *Hunterius*, a genus which no one now accepts. The superior or vertebral extremity of the first pair of ribs is bifurcated. In the right one the bifurcation extends 55 mm., but in the left does not surpass 15 mm. In the left, the part of the rib which thus separates, 15 mm. long, terminates acutely and may be compared to a little horn, which has the apex distant scarcely 2 cm. from the internal border of the rest of the rib, and about 7 cm. from its superior extremity. Its circumference is 45 mm., and at the apex, 25 mm. On the other hand, on the right the portion of the rib which is separate is 55 mm. long. It is somewhat thicker, the termination obtuse, and it is distant its whole length only 3 or 4 mm. from the inner margin of the rest of the rib. So it may even be suspected that in the progress of time this portion might be completely fused with the rest of the rib. Its apex is distant from the superior extremity of the rib only 2 cm. Its circumference at the base is 8 cm., and 9 cm. near the apex. All these relative differences in the degree of bifurcation in the same individual indicate clearly how little of importance there is in the separation of a portion of the rib."[1]

The distal ends of the two ribs constituting the first pair are commonly unequal in breadth. In the different specimens the measurements are as follows:

BALÆNA GLACIALIS BONNATERRE. EUROPEAN AND AMERICAN. BREADTH OF FIRST RIB.

Locality.	Left.	Right.
	in.	in.
Guetaria, Spain	7.0	6.2
Taranto, Italy	3.9	...
San Sebastian, Spain	6.6	5.9
Long Id., N. Y. (Field Col. Mus)	8.0	8.75
Cape Lookout, N. C. (Raleigh Mus.)	6.5	6.75
Long Id., N. Y. (Amer. Mus.)	5.75	6.5
Amagansett, N. Y. (Natl. Mus.)	....	4.5
Charleston, S. C.	4.5	6.0
Coast of New Jersey [2]	3.25	3.85

The length of the first rib in a straight line is as follows:

[1] *Annal. Mus. Civic. Genova*, 14, 1879, pp. 606, 607.

[2] Type of *B. cisarctica*.

BALÆNA GLACIALIS BONNATERRE. EUROPEAN AND AMERICAN. LENGTH OF FIRST RIB.

Locality.	Length of Skull.	Length of First Rib.	
		Left.	Right.
	in.	in.	in.
Iceland, No. I	153.9	50.4[1]	....
Guetaria, Spain	113.4	32.7	38.2
Taranto, Italy	89.3	....	26.0
San Sebastian, Spain	63.0	15.7	15.7
Long Id., N. Y. (Field Columb. Mus.)	152.0	48.0	49.0
Cape Lookout, N. C. (Raleigh Mus.)	152.0	44.5	50.5
Long Id., N. Y. (Amer. Mus.)	128.0	33.5	35.0
Amagansett, N. Y. (Natl. Mus.)	124.0	.....	38.3
Charleston, S. C.	114.5	29.5	29 5
Coast of New Jersey[2]	90.5	28.75	29.0

In the majority of specimens the last pair of ribs is much shorter than the penultimate pair, but in the Raleigh Museum skeleton the last left rib is nearly as long as the rib which precedes it. The right rib is shorter.

STERNUM.

Among European specimens the sternum appears to have been figured only in the case of the Taranto skeleton and Guldberg's Iceland skeleton No. 1. These

FIG. 85.

FIG. 86.

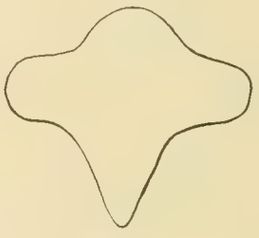


FIG. 87.

BALÆNA GLACIALIS BONNATERRE. STERNUM.

FIG. 85.—TARANTO, ITALY. (FROM GASCO.) FIG. 86.—ICELAND. (FROM GULDBERG.) FIG. 87.—LONG ID., NEW YORK. (AMER. MUS. NAT. HIST.) (FROM A SKETCH.)

two sterna (text figs. 85 and 86) show little resemblance to one another at first sight; nevertheless, it will be perceived that if that of the Taranto skeleton were lengthened posteriorly it would approach that of the Iceland specimen, the form in both cases being rudely heart-shaped.

[1] Whether right or left not specified.

[2] Type of *B. cisarctica.*

The Cape Lookout (N. C.) skeleton, the Cape Cod (Mass.) skeleton in the Museum of Comparative Zoölogy, and that in the Field Columbian Museum, have sterna closely resembling that of the Taranto skeleton (pl. 46, figs. 3 and 4), or rudely heart-shaped, but the skeleton in the American Museum, New York, has the sternum quite different from any of the foregoing (text fig. 87), being cruciform, like the sterna of some specimens of *Balænoptera physalus* L. One might almost believe that it did not belong to the skeleton to which it is attached.

Considering the diversity of form in the sternum of the Finbacks, we need not be surprised at the lack of conformity among the various specimens of the Nordcaper. The sternum in these animals is of little service in discriminating closely allied species.

In the Taranto (Italy) skeleton the sternum is 18 cm. high, 21 cm. wide; in Guldberg's Iceland skeleton, No. 1, 46 cm. high, 37.5 cm. wide; in the Cape Lookout (N. C.) skeleton at Raleigh, 30 cm. high, 38 cm. wide.

SCAPULA.

The scapula of the Nordcaper has a peculiar and characteristic shape, which is quite well shown in Gasco's figure of the Taranto whale (*47*, pl. 6, fig. 8). The glenoid, or posterior border, is evenly concave from the glenoid fossa half-way to

FIG. 88.

FIG. 89.

FIG. 90.

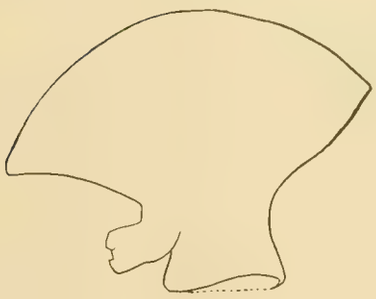


FIG. 91.

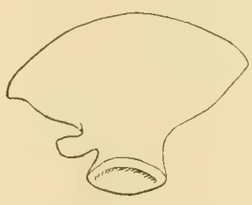


FIG. 92.

FIG. 93.

BALÆNA GLACIALIS BONNATERRE. AMERICAN AND EUROPEAN. SCAPULA.

FIG. 88.—LONG ID., NEW YORK. (AMER. MUS. NAT. HIST.) (FROM A PHOTO.) FIG. 89.—*Ditto.* (FIELD COLUMB. MUS.) FIG. 90.—*Ditto.* (U. S. NAT. MUS.) FIG. 91.—CHARLESTON, S. C. (FROM A PHOTO.) FIG. 92. TYPE OF *B. CISARCTICA.* (OBLIQUE VIEW, FROM A PHOTO.) FIG. 93.—TARANTO, ITALY. (FROM GASCO.)

the suprascapular border, but distally becomes nearly straight. The suprascapular border is regularly convex; the coracoid, or anterior, border, is short and nearly straight, but presents near the juncture with the suprascapular border a tubercle which causes a convexity in the outline. The acromion is large, and directed outward or downward. The shape of the anterior and posterior borders is very characteristic of the species. Among American specimens this peculiar form is found well developed in the type of *B. cisarctica* Cope, at Philadelphia, in the Amagansett (N. Y.) skeleton in the National Museum (No. 23077), in the Charleston skeleton, in the skeleton in the Field Columbian Museum, Chicago; and less well defined in the Long Id. (N. Y.) skeleton in the American Museum of Natural History. Holder's figure of the scapula of this skeleton is taken at an angle and does not, therefore, show the true shape. (See text figs. 88 to 93; also pl. 45, figs. 2–5.)

The following are actual measurements of the greatest breadth and height of the scapula in various American and European specimens:

BALÆNA GLACIALIS BONNATERRE. EUROPEAN AND AMERICAN. SCAPULA.

Museum.[1]	Length of skull.	Scapula.	
		Greatest breadth.	Greatest height.
	in.	in.	in
Christiania (Capt. Berg, III)	154.3	49.2	41.1
" (Capt. Berg, I)	153.9	48.0	42.5
New York	128.0	36.0	29.0
Washington	124.0	37.5	29.0
Charleston	114.5	36.0	24.5
St. Sebastian (Guetaria)	113.4	32.7	25.2
Philadelphia[2]	96.5	30.0	23 0
Taranto	89.3	27.6	21.6

A scapula from a partial skeleton found at Beaufort, North Carolina, has, according to Mr. R. L. Garner, a breadth of 51 inches. The Raleigh Museum skeleton, which is as large as the Christiania skeleton No. 2, is, unfortunately, without the scapulæ. Cope recorded in 1868 that there was in the museum of Rutgers College, New Brunswick, N. J., a scapula 48½ in. broad and 36 in. high. He estimated that this indicated an individual 57 feet long, but in view of the dimensions given in the foregoing table this appears improbable.[3]

PHALANGES.

Gasco gives (*47*, 40) the following formula for the Taranto skeleton, I, 0?; II, 4; III, 5; IV, 3; V, 3. Professor Rios y Rial also gives a formula for the Guetaria skeleton, but it appears to be entirely hypothetical.

[1] See table on p. 255. [2] Type of *B. cisarctica*.

[3] See *Proc. Acad. Nat. Sci. Phila.*, 1868, p. 194, where a few other remarks regarding the present species are made.

In none of the American specimens do the phalanges appear to be in their natural positions, and in several of the skeletons a considerable number are lost. It is impracticable, therefore, to give a reliable formula, but the following are taken from mounted specimens in the American museums:

BALÆNA GLACIALIS BONNATERRE. AMERICAN. PHALANGES.

Locality.	Museum.		Digits.				
			I	II	III	IV	V
Provincetown, Mass.....	Mus. Comp. Zoölogy.....	Right	1	4	5	3	3
		Left	1	4	5	3	3
Long Island, N. Y.....	Field Col. Mus.	Right	2	4	5	2 +	3
		Left	2	4	5	2 +	3
Long Island, N. Y.....	Amer. Mus. Nat. Hist.....	Left	2	4	5	4	4
Amagansett, N. Y.....	U. S. Nat'l Mus., No. 23077	Right	1	4	4	2	3[1]
		Left	1	4	4	2	3[1]

SUMMARY.

The foregoing discussion of European and American specimens of the Nordcaper, or Black whale, leads to the following general statements and conclusions:

1. Specimens from the two sides of the Atlantic are alike in size.

2. The external proportions, so far as can be ascertained from the scant data available, show very considerable variability, but the variations are indefinite and give no ground for separating the American from the European specimens. It is probable that much of the apparent variability is due to inaccurate measurements.

3. The whalebone in the largest American specimen is of the same length as the largest Iceland whalebone.

4. The majority of both European and American specimens are uniform black throughout.

5. The number of ribs and vertebræ is the same in specimens from both sides of the Atlantic. The vertebral formula is the same, except that American specimens appear to have normally 11 lumbars, while European specimens, according to Guldberg and Gasco, have 12 lumbars normally. The reasons why this difference cannot be regarded as having the importance it would at first appear to have are given on page 251.

6. The points in the vertebral column at which the processes of the vertebræ become obsolete are the same in both American and European specimens, but the data in relation to the latter are meagre.

7. Photographs of the skull of the Long Id., New York, skeleton in the National Museum agree very closely indeed with Gasco's figures of the skull of the Taranto (Italy) skeleton, in which the outlines are also from photographs. On

[1] There is no probability that this formula is correct.

the other hand, the measurements of the various skulls show considerable discrepancies. These do not, however, tend to divide the skulls into two groups, according to locality. In this connection it is necessary to hold in mind that the majority of the skulls are those of young individuals.

8. The length of the first rib is the same in European and American skeletons of equal size. The breadth of the first rib at the distal end is variable in both series of specimens, and often differs much on the two sides of the body in the same specimen.

9. The sternum is variable in shape, with no constant difference between European and American specimens.

10. The scapula has the same characteristic form in both European and American specimens.

While there are many points regarding the Nordcaper that need to be further investigated, there is at present, so far as can be ascertained from the material available, no valid reason for separating the American from the European specimens as distinct species.

OPINIONS REGARDING THE IDENTITY OF THE RIGHT WHALES OF THE EASTERN AND WESTERN ATLANTIC (INCLUDING WITH THE LATTER COPE'S *B. CISARCTICA*.)

It has seemed to me desirable to sum up again, as did Holder in 1893, the opinions of cetologists regarding the relationship of "*B. biscayensis*" to *B. cisarctica*.

It is well known that several systematic writers of the eighteenth century, following for the most part the more or less indefinite statements of Zorgdrager and Martens, distinguished two species of northern Right whales, the Greenland or Spitzbergen whale and the Nordcaper. The story of the union of these species by Cuvier and their subsequent separation by Eschricht is familiar to every cetologist. Cuvier was, of course, acquainted with the fact that the Basques pursued Right whales on both sides of the North Atlantic,[1] but as he regarded all whales of the genus *Balæna* in these waters as forming one species, any critical consideration on his part of differences between those of the western and those of the eastern Atlantic was precluded.

A principal object of the researches of Eschricht upon the northern Right whales was the demonstration of the correctness of the suspicions which he entertained as early as 1840 that the Nordcaper was specifically distinct from the Greenland Right whale,[2] but he did not have under special consideration at any time the question of the identity of American specimens of the former species with those from the European coasts. Indeed, so far as I am aware, there were no American specimens of *B. biscayensis* in European museums in his day.[3] Nevertheless, in the work Om

[1] See ESCHRICHT and REINHARDT, "Om Nordhvalen," *Videns. Selsk. Skr., 5 Række, naturvidens. og math. Afd.*, 5 Bd., 1861, p. 479, foot-note 5. [2] See *Comptes Rendus*, 1860. Separate, p. 2.

[3] See GASCO, "Intorno alla Balena presa in Taranto, *Atti R. Ac ad. Napoli*, 1877, p. . Separate, 1878, pp. 12–13.

Nordhvalen, published in conjunction with Prof. Reinhardt in 1861, he mentions the "Nordcaper" as "probably the same species as that from the coasts of Nantucket and New England which the Anglo-Americans already call 'Right whale.'" [1]

The question was first forced on the attention of cetologists in 1865, when Cope published the description of his *B. cisarctica* (*22*, 168). Cope did not examine the San Sebastian skeleton on which *B. biscayensis* was based, but remarks regarding his *B. cisarctica* as follows: "This species may readily occur on the European coasts, and is, no doubt, allied to, or the same as, the species pursued by the Biscay whalers, which Eschricht says is related to the *australis*. This does not appear to have been described, though catalogued without reference by Gray and Flower under the name of *biscayensis* (*22*, 169)." It is stated by Cope, however, that he did study the skeleton of *B. australis* in the *Jardin des Plantes*, and that his species is "strongly separated" from that form.

Van Beneden in 1867 quotes Cope's opinion as to the probable identity of the *B. cisarctica* with the Biscay whale, and remarks that Cope holds this view "*avec beaucoup de raison.*" He also adds: "It is then from America that we should hear the facts regarding the history of this animal which during centuries visited our [European] coasts, and which has contributed largely to the prosperity of our hardy neighbors of the North [the Dutch, etc.]" (*3*, sep. 8).

In his memoir on the Taranto whale, Gasco remarks in 1878: "Although so brief, the summary reported by Prof. Cope on the whale captured opposite Philadelphia in 1862 leaves no doubt as to the determination of the Taranto whale. They are counterparts (*sorelle*); both belong to *Balæna biscayensis* Eschricht" (*47*). The same statement is repeated in the *Comptes Rendus Acad. Paris*, 87, 1887, p. 410. He also states that he compared a replica of a cast of the earbone of the type of *B. cisarctica* belonging to the Civic Museum of Milan with that of the Taranto whale and found that they were identical (*47*, 25).

In 1879, Gasco published a description of the type of "*B. biscayensis.*" He appears to take for granted the identity of that species with *B. cisarctica*, and in the course of his article, quotes a conversation with Cope, whom he met in Paris. Cope is reported as saying that the Philadelphia whale (type of *B. cisarctica*) exactly resembles that of Tarento ("*B. biscayensis*") (*48*, 581, footnote 2).

The Ostéographie of Van Beneden and Gervais, which bears the date of 1880, does not contain as much original matter regarding the Atlantic Right whale as is the case with other species. The authors state that they examined neither the type of "*B. biscayensis*" nor that of *B. cisarctica*, but that they "do not doubt" that the two species are identical (*8*, 103). Later in the same work they remark: "This whale [*B. cisarctica*] is no other than the *Balæna biscayensis*" (*8*, 236).

In 1883, Holder summed up the opinions regarding the affinities of *B. biscayensis* and *B. cisarctica* (*61*, 117). He includes the opinions of most of the authors above cited and adds some independent testimony. Among these addi-

[1] Page 469.

tions is the opinion of Flower after seeing the figure published by Holder, as follows: "As far as I can make out it is the same as "*B. biscayensis*"; also that of Dr. J. A. Allen: "Your drawing of the recent [New Jersey] specimen agrees well with the figure of *B. biscayensis* of southern Europe, which I believe to be identical with Cope's *B. cisarctica*."

In 1889, Van Beneden stated explicitly his opinion that *B. cisarctica* was identical with *B. biscayensis*. He remarks: "The *Balæna biscayensis* of Eschricht is the *Sletbag* (whale with smooth back) of the ancient Icelandic whalers, the *Nord-Caper* of the Dutch whalers, and the *Sarde* of the French whalers (Du Hamel). . . . It is the same animal as that to which Professor Cope of Philadelphia has given the name of *Balæna cisarctica*, and Professor Capellini that of Taranto whale, *Balæna tarentina* (*Balæna Van Benediana*). The *Balæna Swedenborgii* [Lilljeborg; subfossil in Sweden] is also a synonym of this species" (*7*, 15). Again: "Professor Cope has had the courtesy to send us from Philadelphia an earbone of an adult animal, and by our invitation Prof. Reinhardt has compared it with that of the skeleton from Pampeluna [type of "*B. biscayensis*"] which is in Copenhagen. Although the former bone is from an adult animal and the second from a young animal, it is not doubtful, according to Prof. Reinhardt himself, that these bones only present such differences as depend upon age" (*7*, 17).[1]

In an article on *B. biscayensis*, published in 1891, Guldberg treats the descriptions of Cope, Gasco, etc., as referring to one and the same species, occurring on both sides of the Atlantic. This view was not, so far as I can ascertain, based on examination of specimens (*58*). The same opinion was again broached in 1893 (*59*).

From the foregoing statements, it will be seen, as pointed out by Holder, that the opinions of those most competent to judge in the matter have leaned strongly toward the identification of *B. biscayensis* with *B. cisarctica*. Two important names, however, must be cited among those who take the opposite view,—Reinhardt and Fischer.

Although Reinhardt was joint author with Eschricht of the work Om Nordhvalen, in which, as we have seen, the opinion is set down that the two species are identical, in the Ostéographie of Van Beneden and Gervais we find in connection with the account of Reinhardt's comparison of the ear bones of the type of *B. biscayensis* with one of *B. cisarctica*, the following: "Prof. Reinhardt does not believe, however, that the *Balæna biscayensis* is a synonym of *Balæna cisarctica*" (*8*, 107). If Reinhardt is correctly reported in this place, we must suppose that his opinion changed subsequent to the publication of the work Om Nordhvalen, or that the statement in the latter is to be credited to Eschricht alone. No explanation is given by Van Beneden and Gervais of the grounds of Reinhardt's opposition to the prevailing view.

The second cetologist who has dissented from the union of the Right whales of the European and United States coasts in one species is M. Paul Fischer.

[1] It is difficult to harmonize this last remark with the statements in the Ostéographie (see p. 107 of that work).

In support of his opinion, he brought forward in 1871 (*42*) two characters as distinguishing *biscayensis* not only from *cisarctica* but from *australis* and *antipodarum*. The first is drawn from a fragment of a rib found at Biarritz, which is "regularly oval, without appreciable angle, ridge, or crest." The fragment has a maximum diameter of 11 cm. and minimum diameter of 8½ cm. This rib, according to Fischer, is "infinitely more massive, more rounded, and thicker" than in *Balæna mysticetus*, *australis*, or *antipodarum*, and lacks the crest found in those species.

As a second distinguishing character of *B. biscayensis*, Fischer points to the bifid first rib of the type specimen from San Sebastian, not found in *cisarctica* or *australis*. He remarks further: "As to the whale of the east coast of North America, nothing proves to me its identity with the Basque whale. The Basque whalers themselves, after having almost destroyed the whales of the Bay of Biscay, spread out westward and in 1372 reached the banks of Newfoundland,[1] where they saw a whale which they judged different, and called 'Sardaco Baleac.' It was smaller than the Biscay whale" (*42*, 299).

As regards the size of the rib found at Biarritz, it is to be said that in the skeleton from Pt. Lookout, North Carolina, in the Raleigh museum, the largest rib has a maximum diameter of 12.7 cm., and two others a diameter of 10.2 cm. This was an adult male 50 ft. long. The largest ribs in the skeleton in the American Museum, New York (which is about 40 ft. long), have a diameter of 9.75 cm., and the maximum diameter of the 3d rib in the 39-foot Taranto specimen, as shown by Gasco's figures, is 10 cm. It will be seen, therefore, that Fischer's measurements of the Biarritz rib are not remarkably large. The smoothness of that fragment is hardly a reliable character, as it is well known that the shape of the ribs is quite variable, not only in the same species, but among the various pairs in a single skeleton.

In considering the importance of the bifurcation of the proximal end of the first pair of ribs in the type of *B. biscayensis*,—the second character brought forward by Fischer as distinguishing that species from *cisarctica*,—it will be interesting to read Gasco's description, quoted on p. 257. This shows that the bifurcation occurs on both sides, but is of small extent and is unequal on the two sides. As stated by Gasco, the Taranto whale is without this bifurcation of the first rib, and such is the case in all the American specimens of *B. cisarctica* I have examined. The *B. biscayensis* at San Sebastian (*not the type*) has the bifurcation on one side only, and that but slightly developed.[2]

In another paper, published in 1872 (*43*, 19), Fischer again sums up his opinions regarding *B. biscayensis* and *B. cisarctica*, as follows:

"The *Balæna biscayensis*, the Nordcaper of the Norwegians and Icelanders, and the *Hunterius svedenborgi* ought, it seems to me, to be assembled in the same genus, if not in the same species, very close to the *Hunterius temmincki* of the

[1] Regarding this statement, see p. 267.

[2] See GRAELLS, *Mem. R. Acad. Cien. Madrid*, 13, pt. 3, 1889, pl. 4, fig. 6.

Cape of Good Hope. These different whales have for common characters a very small head, a bifid first rib, the lower ends of the ribs very thick and almost round.

"The Sarde of the Newfoundland banks, and the *Balæna cisarctica* of the coast of North America, belong to a different group, very near to the *Balæna australis* of the Cape of Good Hope, and the *B. antipodum* of New Zealand. The head is comparatively longer than in *Hunterius;* the first rib is simple; the lower extremities of the ribs are compressed.

"There exist then in our temperate regions of the Atlantic at least two species of Right whales."

In 1881, Fischer again raised the question of the number of species of Right whales in the North Atlantic (44, 33–55), but by this time had somewhat modified his views. He reviews the literature of the subject, ancient and modern, and devotes two pages to conclusions. These are in brief as follows:

1. That "it may be considered very probable that (*a*) the 'Nordcaper,' (*b*) the 'Sletbag,' (*c*) *Balæna tarentina* of Capellini, and (*d*) *Balæna biscayensis* belong to the same species, as well as the fossil species *B. lamanoni, glacialis*, and *svedenborgi*."

2. That "the 'Sarde' and *B. cisarctica* of Cope are synonyms and (awaiting fuller information) distinct—at least as a race—from the whale of the Basques, by the longer head. The skeleton is otherwise similar."

3. That *Halibalæna britannica, B. vanbenedeniana*, and *B. mediterranea* "have not sufficient characters to be classified," and can be as well associated with the Nordcaper as with *B. mysticetus*.

Fischer adds the following: "A species, among cetaceans, is perhaps what we call a genus; and in that case, the Nordkaper would be a single one, with two or three races, with distinct geographical distribution."

The second of the foregoing opinions is that which is of most interest in the present connection. On page 41, Fischer makes the remarkable statement, already mentioned elsewhere (see p. 13), that armed with the compass and "balestrille" the Basques roamed westward in the Atlantic and in 1372 discovered the banks of Newfoundland, where they saw whales in abundance. This statement appears to rest on a memoir prepared by the merchants of St. Jean de Luz and Cibourre in 1710, and published in 1857.[1] The whale which they first found here, according to Fischer, they considered different from the whale of the Bay of Biscay, and called *Sardaco Baleac*, or the whale which goes in herds or schools, in contradistinction to the former, which appears singly. Continuing their explorations, they entered the Gulf of St. Lawrence where they found still another and better whale which they called *Grand Bayaco Baleac* or Grand Bay whale. They afterwards recognized this as the same as the Greenland whale, *B. mysticetus*, found at Spitzbergen.

The character of the evidence on which these statements rest is unknown to

[1] "Mémoire addressé en 1710 à M. de Planthion, syndic général du pays de Labourd, par les négociants de Saint-Jean-de-Luz et de Cibourre." (Journal *La Gironde*, 29 Avril, 1857.)

me, but it appears singular that the matter has not attracted the attention of American historians, considering its importance in connection with the history of the discovery of America.

The "Sarde" should, of course, be the Right whale of the Atlantic coast of the United States, Canada, and Newfoundland, *B. cisarctica* Cope. Fischer, even, seems to have little doubt of that fact. He recalls Gray's claim that it is distinct because it has 14 pairs of ribs, while the San Sebastian whale has 15[1] and furthermore has the first pair bifurcated, but is not impressed with the importance of these distinctions. He adds:

"The notable difference which I find between the *B. cisarctica* and the Biscay whale is the greater relative length of the head of the former. According to the measurements given by Cope, the length of the head in *B. cisarctica* is to the total length as 1 to 3.69; in Segnette's whale the proportion is 1 to 4; in the young whale of San Sebastian the proportion is still less, and approaches 1 to 5. We shall see further on that the whale stranded at Taranto in 1877 has the head extremely small, 1 to 5."[2]

What is meant by the "head" in this and other discussions of proportions by various European authors is not clear. The length of the skull as compared with that of the skeleton is as follows in various American and European specimens:

BALÆNA GLACIALIS BONNATERRE. AMERICAN AND EUROPEAN. LENGTH OF SKULL.

Locality.	Sex.	No. of times length of skull is contained in length of skeleton.	Authority
Charleston, S. C.	?	3.73	F. W. T.
San Sebastian, Spain		3.63	Gasco
Guetaria "		3.63	Graells
Cape Lookout, N. C.	?	3.53	F. W. T.
New Jersey		3.74[3]	Cope
Taranto, Italy	♀	4.77[4]	Gasco

It will be observed that the proportion is remarkably constant in both the American and the European specimens, considering the uncertainties involved in comparing measurements made by different observers. The Taranto skeleton alone offers a marked departure. Considering the whole series, it hardly seems probable that there is any real foundation for the character brought forward by Fischer.

[1] Incorrect—Gasco gives 13 pairs, but considers that there may have been 14 pairs.

[2] "From the animal in the flesh; but from the skeleton this proportion is not more than 1 to 3.98, or in round number, 1 to 4." (Foot-note by FISCHER.)

[3] Type of *B. cisarctica*, Cope's measurements. My own measurements give 3.84.

[4] See Fischer's foot-note.

NOTE.—Since the foregoing account of *Balæna glacialis* was written, I have received from Mr. J. Henry Blake of Cambridge, Mass., some measurements of the male specimen found dead off Highland, Cape Cod, Mass., April, 1895. These are as follows:

	ft.	in.	Per cent.
Total length, tip of lower jaw to notch of flukes	42	5	100.0
Tip of lower jaw to ant. insertion of pectoral	17	0	40.0
Upper jaw to blowhole	9	2	21.6
" " " ant. insertion of pectoral	14	0	33.0
Length of pectoral from anterior insertion	6	0	14.1
Breadth of pectoral	2	9	6.5
Breadth of flukes (tip to notch and notch to tip again)	13	6	31.8
Length of blowholes	0	8	....
Distance between blowholes anteriorly	0	7	....
Longest whalebone	5	6	....

A large, flat knob, or "bonnet," near tip of upper jaw.
Several large, long knobs on the median line of the caudal peduncle superiorly, near the flukes.
Notch of flukes narrow and deep.
Whalebone all black.
This individual is figured on plate 46, figs. 1, 2.

CHAPTER IX.

WHALEBONE WHALES OF THE EASTERN NORTH PACIFIC OCEAN.

Present knowledge of the large whales of the west coast of North America rests almost exclusively on the observations of Capt. C. M. Scammon, made more than thirty years ago. The record of these observations, together with some pieces of whalebone, bones, etc., was sent by Capt. Scammon to the Smithsonian Institution. The manuscript was placed by the secretary of the Institution in the hands of Professor E. D. Cope, who edited it and published it in the name of Capt. Scammon, and at the same time described a number of the species as new (*83*).

Later, Capt. Scammon published his well-known work entitled Marine Mammals of the Northwestern Coast of North America (*82*), in which additional information was given regarding the various species, together with more elaborate figures. This work was accompanied by an appendix by Mr. Wm. H. Dall, giving a list of species and valuable measurements, references to specimens, etc.

In 1872 Capt. Scammon published a description of a small *Balœnoptera*, under the name of *B. davidsoni*, which had been omitted from the large work (*81*). Very little has been added since Capt. Scammon's time either in the way of new observations or specimens, and the present knowledge of these West Coast whales is still very incomplete.

In 1893 the skeleton of a Humpback whale from the West Coast was exhibited in the World's Columbian Exposition. A few notes on it which I made at the exposition are given on a subsequent page. Photographs of a Humpback killed in Henderson Bay, Puget Sound, were obtained by the National Museum in 1896. In 1899 a fine adult skeleton of a West Coast Finback, which had been formerly the property of Prof. Cope, was mounted and exhibited in the Wistar Institute, Philadelphia. The greater part of the material sent to the Smithsonian Institution by Capt. Scammon in 1869 and subsequent years is still in the National Museum, and has been examined and verified by the writer.

Observations of the large whales of the western shores of the North Pacific have been recorded by Pallas (*72*, 286–288), Temminck and Schlegel, Gray (*53*, 96; *54*, 1; *55*, 43), Möbius (*70*), and others. These observations, of course, throw light on the identity of the species of the American coasts and the scientific names in some instances doubtless have priority over those of Cope. While it is not possible at the present time to investigate the identity of the species in the same detail as in the case of the Atlantic species, it seems desirable to review the subject in the present connection, and to add such new information as has accumulated.

It is certain, as pointed out by Van Beneden (*8*, 234) and others, that the whales of the North Pacific bear a strong resemblance to those of the North Atlantic, so much so that the question of their identity with them may properly be raised. To this statement a notable exception must be made in the case of the Gray whale, *Rhachianectes*, which has no counterpart in the North Atlantic, since it is now certain that the genus *Agaphelus* of Cope, supposed to be based on an allied Atlantic species, is fictitious. There is no reasonable doubt that the following Atlantic and Pacific species are closely allied in the manner indicated:

PACIFIC SPECIES.			ATLANTIC SPECIES.
"Cullamach" whale	allied	to	*Balæna glacialis* Bonnat.
Megaptera versabilis	"	"	*Megaptera nodosa* "
Balænoptera velifera	"	"	*Balænoptera physalus* (L.)
Sibbaldius sulfureus	"	"	*Balænoptera musculus* (L.)
Balænoptera davidsoni	"	"	*Balænoptera acuto-rostrata* (Lac.)

Balænoptera borealis of the eastern North Atlantic has no representative, so far as known at present, in the North Pacific,—an interesting circumstance.

Balæna sieboldii Gray (?).

The whale mentioned by Scammon under the name of the "Right whale of the Northwestern Coast," must be dismissed with a few words, as no new material is at command by means of which to determine its identity. Scammon (*82*, 66) states that "the color of the Right whale is generally black, yet there are many individuals with more or less white about the throat and pectorals, and sometimes they are pied all over. Its average adult length may be calculated at 60 feet—it rarely attains to 70 feet,—and the two sexes vary but little in size. Its head is very nearly one third the length of the whole animal, and the upper intermediate portion, or the part between the spiracles and 'bonnet,' has not that even spherical form, or the smooth and glossy surface present with the Bowhead, but is more or less ridgy crosswise. Both lips and head have wart-like bunches moderately developed, and in some cases the upper surface of the head and fins is infested with parasitical crustaceans."

Pechuel in 1871 (*73*, 1184) published a figure of a Right whale killed near the Aleutian Ids. during his expedition. It resembles Scammon's figure in a general way, but is entirely black. No measurements could be taken on account of stormy weather.

The whalebone, as far as may be judged from pieces in the National Museum, is entirely black, occasionally with a bluish or greenish tinge, but without the distinct whitish stripes which occur in many specimens of the whalebone of *B. mysticetus*. The bristles are coarser than in the latter species. The following are the lengths of the pieces in the National Museum which may be assigned to this species:

		Length.
No. 57,135.	"Japan." Bought of Wm. Philips & Son, New Bedford, Mass., 1883...	8 ft. 6 in.
" 13,990.	Sea of Japan. Capt. C. M. Scammon, 1873.....	8 " 2 "
" 13,988.	N. W. coast of America. Capt. C. M. Scammon.....	8 " 2 "
" 57,134.	"Northwest." Bought of Wm. Philips & Son, New Bedford, Mass., 1883	7 " 2 "

Regarding this species, Van Beneden remarked in 1875 (*5*, 37): "It seems to us demonstrated and confirmed to-day . . . that the whale of the coasts of Japan is a distinct species, and occurs in the North Pacific as the Basque whale occurs in the North Atlantic."

Megaptera versabilis Cope.

Cope described this species from the data furnished by Scammon (*83*, 15). These data include the following characters:

1. "A short body with immense belly, and frequently diminutive 'small'; inordinately large pectorals and flukes."

2. "A protuberance, of variable shape and size in different individuals, placed on the back about one fourth the length from the flukes, is called the hump."

3. "The top of the head is dotted with irregular rounded bunches, that project above the surface about a half inch, each covering about two inches of space."

4. "Number of folds on the belly twenty-six, averaging in width from four to eight inches."

5. "Color of body black, under side of pectorals white. Frequently the under side of the flukes is white likewise, and sometimes the greater portion of the belly."

6. "The Humpback has also growing on its body what are termed barnacles, which appear to collect most on the fins, flukes, and head."

"The following measurements and memoranda were taken by Capt. F. S. Redfield, of the whaling and trading brig *Manuella*, while cruising in Behring Sea, September 17th, 1866"[1]:

	Ft.	In.
Extreme length.....	49	7
Length of pectorals.....	13	7
Breadth " "	3	2
Distance from snout to pectorals.....	12	0
" " corner of mouth to snout.....	9	6
" " eye to snout.....	10	2
" " spoutholes to snout.....	9	4
Breadth of flukes.....	15	7
Depth " "	3	4
Distance from anus to flukes.....	11	6
" " genital slit to flukes.....	17	0
Length of folds on belly.....	16	0
Whole breadth of folds on belly.....	10	0

[1] These measurements were corrected in the Marine Mammals, p. 39, and the later figures are given here.

	Ft.	In.
Distance from flukes to hump	12	3
Length of hump along the back	3	0
Height " "	1	0
Depth of small close to flukes	2	6
Thickness of small close to flukes	1	6

The characters included in the foregoing paragraphs are all identical with those of *M. nodosa*, except that relating to the position of the dorsal fin, which is said to be "about one fourth the length from the flukes," while in *M. nodosa* the distance from the posterior margin of the flukes is almost exactly one third the total length. This character is undoubtedly drawn from the measurements cited above. How far these measurements are reliable can not be exactly ascertained. As given in the Marine Mammals, they are considerably changed from the figures of 1869. It will be seen later that in another specimen measured by Scammon the distance from the posterior margin of the dorsal fin to the snout was exactly two thirds the total length.

The length of the pectorals, according to these measurements, is 27.4 % the total length, as against 27.0 % to 31.0 % in *M. nodosa*. The breadth of the pectorals is 6.4 %, against 6.1 % to 7.6 % in *M. nodosa;* height of dorsal fin, 2.0 % against 1.9 % to 2.5 %. The approximation must be regarded as very close.

Professor Cope considered the presence of tubercles on top of the head as constituting a distinguishing character, but such is, of course, not the case.

Scammon's observations in the Marine Mammals (*82*) include those employed by Cope in establishing the species *M. versabilis*, with others of equal importance. He gives notes on the color and some other features of three additional specimens from California. These are as follows:

No. 1. Female. Color of body, black above, but more or less marbled with white below. Fins, black above, and dotted with white beneath. Number of folds on throat and breast, 21, the widest of which were 6 inches.

No. 2. Female. Color of body black, with slight marks of white beneath. Color of pectorals, black above, white below. Color of flukes, black above and below. Gular folds, 18. Tubercles on lips, 9.

No. 3. Female. Color of body black above, slightly mottled with white and gray below. Fins and flukes, black above, white beneath. Number of laminæ of whalebone 540; black, streaked with white, or light lead color.

Scammon remarks further:

"The usual color of the Humpback is black above, a little lighter below, slightly marbled with white or gray; but sometimes the animal is of spotless white under the fins and about the abdomen. The posterior edge of the hump, in many examples, is tipped with pure white" (*82*, 41).

After referring to the various normal species of Gray, Scammon adds:

"We have frequently recognized, upon the California coast, every species here

described, and even in the same school or 'gam.' Moreover, we have experienced the greatest difficulty in finding any two of these strange animals externally alike, or possessing any marked generic or specific differences. If the differences pointed out as constituting different species are maintained, we conclude there must be a great number. We have observed, both in the dead and living animals, the following different external marks: 1st. Body black above, white beneath. 2d. Body black above and below, with more or less white mottling under the throat and above the abdomen; pectoral and caudal fins white beneath, or slightly spotted with black. 3d. Body black above, white beneath, with underside of pectoral and caudal fins of a dark ash-color. 4th. Body black above, with gray mottling beneath. In all of these varieties, both the caudal and pectoral fins differ in shape and size; the latter in some individuals being exceedingly long, narrow, and pointed, while others are comparatively short and broad, as shown in the outline (page 47), which also shows the parasites, commonly called barnacles, adhering to the throat, pectorals, and caudal fin. There are still others whose pectorals are of intermediate proportions, but terminate abruptly, as seen on page 48, which also represents the scalloped flukes present in some of the individuals. Again, in other examples, the caudal fin is narrow, pointed, and lunate; in others, still, it is broad, and nearly straight on the posterior edge. All these varieties feed and associate together on the same ground, and in every particular their habits are the same, so far as we have been able to ascertain from careful observation; all, likewise, are infested by the same parasites. As to the dorsal protuberance called the hump, it is, as has been previously stated, of no regular shape or size, but is nearly of a uniform height; the posterior edge is sometimes tipped with white. As to the tubercles on the head and lips, they were present on all we have examined, twenty or more specimens; those about the head are always well-developed, while those upon the lips, in many individuals, are scarcely perceptible. In some instances, however, they equal or exceed those which crown the skull. There is no regularity in the number of gular folds, which, as far as observed, vary in number from eighteen to twenty-six. In some cases they run parallel to each other; but usually there are several that either cross or terminate near the pectorals. The animals are all described as being black above; but in the examples which have been examined, there was not one when closely scrutinized, which did not reveal some light marks of white." (*82*, 43, 44, foot-note.)

It will be seen that the range of color variation is about the same in the Pacific Humpback, as in the Atlantic species. The pectorals are perhaps more frequently black externally, but as they are also pure white at times, as shown by the photographs above-mentioned, this can hardly be looked upon as indicating a specific difference. (See pl. 41, figs. 1, 2.)

The number of abdominal ridges is not different from that found in *M. nodosa.*

One peculiarity merits attention. Scammon states that some parts of the body in the Pacific Humpback are occasionally gray. The Newfoundland Humpbacks which I examined were all black and white, without gradation or intermingling so as to produce shades of gray, but Rawitz (*74*) has stated that one of the Humpbacks examined by him at Bear Id., Norway, was gray on the throat.

Scammon gives measurements of the three specimens above mentioned, which, together with a part of the earlier ones, are as follows:

MEGAPTERA VERSABILIS COPE. CALIFORNIA AND BERING SEA.

Measurement.	No. 1. California. 1872. ♀ Scammon.	No. 2. Ditto. ♀	No. 3. Ditto. ♀	Bering Sea. 1866. ♂ Scammon.
	ft. in.	ft. in.	ft. in.	ft. in.
Total length	48 0	48 0	52 0	49 7
Snout to eye	10 10	.....	12 5[1]	10 2
" " blowholes	8 0	.....	10 0[1]	9 4
" " corner of mouth	10 0	.....	11 9[1]	9 6
" " pectorals	16 0	16 6	.....	12 0
" " dorsal fin	28 0	.....	.....	.....
Notch of flukes to anus	12 6	11 6	.....	11 6
" " " " genital slit	12 11	12 0	.....	17 0
Navel to genital slit	5 0	.....	.....	.....
Length of pectorals	13 0	13 0	12 0	13 7
Breadth of pectorals	3 5	3 0	3 6	3 2
Height of dorsal fin	0 10	.....	.....	1 0
Length " " "	4 0	.....	.....	3 0
Breadth of flukes from tip to tip	18 0	14 0	.....	15 7
Antero-posterior breadth of lobes of flukes	3 6	4 3	.....	3 4
Eye to ear	2 0	.....	.....	.....
Length of orifice of ear	0 1¼	.....	.....	.....
" " genital slit	3 6	.....	.....	.....
From pectorals to top of back	4 6	.....	.....	.....
" corner of mouth to top of head	5 4	.....	.....	.....
" eye to top of head	4 6	.....	.....	.....
Girth below pectorals	25 0	.....	.....	.....
Depth of caudal peduncle at insertion of flukes	1 9	.....	.....	2 6
Length of longest baleen	.....	2 9	2 8	.....
Breadth " " "	.....	0 10	0 9	.....
Length of fringe of baleen	.....	.....	0 5	.....

Reduced to percentages of the total length, these measurements are as follows:

MEGAPTERA VERSABILIS COPE. CALIFORNIA AND BERING SEA.

	No. 1. California. 1872. Scammon.	No. 2. Ditto.	No. 3. Ditto.	No. 4. Bering Sea. 1866.
Sex and age	♀	♀	♀	♂
Total length	48′ 0″	48′ 0″	52′ 0″	49′ 7″
	%	%	%	%
Snout to eyes	20.8	.....	[23.2]	20.5
" " blowholes	16.6	.....	[18.6]	18.8
" " pectorals	33.3	34.4	.....	.....
" " post. margin of dorsal fin	[66.6]	.....	.....	.....
Length of pectorals	27.1	27.1	23.1	27.5
Breadth " "	7.1	6.2	7.0	6.4
Height of dorsal fin	1.7	.....	.....	2.0
Breadth of flukes	37.5	30.0	.....	31.4

[1] From lower jaw.

The averages of these several percentages, compared with those of the three Snook's Arm, Newfoundland, Humpbacks which I measured, are as follows:

MEGAPTERA VERSABILIS AND *M. NODOSA*. NORTH PACIFIC AND NEWFOUNDLAND.

Measurement.	North Pacific.	Newfoundland.
	%	%
Snout to eye	(3) 21.5	24.7
" " blowholes	(3) 18.0	(2) 18.9
" " pectorals	(2) 33.9	32.4
Length of pectorals	26.2	(2) 28.5
Breadth " "	6.7	(2) 7.6
Height of dorsal fin	(2) 1.9	(2) 2.3
Breadth of flukes	(3) 33.0	(2) 37.6

The agreement exhibited is quite close, except as regards the distance from the tip of the snout to the eye, and the breadth of the flukes. The reason for the discrepancy in the former measurement is not clear, as the photographs at command do not show any noticeable difference in the position of the eye. Though there is no doubt considerable variation in the actual breadth of the flukes, all measurements of this part both in the present and the Finbacks vary more than could be expected. There appears to be some difficulty in measuring the flukes accurately, or else different observers use different methods of measurement.

The photographs of the Humpback taken in Henderson Bay, Puget Sound, Washington, September 5, 1896, reproduced in plate 41, figs. 1–4, confirm many of the characters given by Scammon, and afford others showing that the species bears the strongest possible resemblance to *M. nodosa*.

Thus, the dermal tubercles on the head are arranged in three rows,—a median one and a double one on each side. The median row has about 6 tubercles and each lateral one about 10, as in *M. nodosa*. There is a cluster of tubercles at the symphysis of the mandible, and about 10 on each ramus. The dorsal fin is low, with a *concave* anterior border, and a knob-like tip, as in one of the Newfoundland specimens.[1] A deep furrow extends backward from the mouth across the shoulder. The pectorals are white above with a median dark mark proximally; below, entirely white. The flukes are undoubtedly more or less white below. Unfortunately, the pectorals are turned in such a position that the emarginations on the anterior border cannot be seen. This whale, according to an account published in the *Northwest Magazine* May, 1897, was 45 ft. long; the pectoral fins about 9 ft. long; the flukes 13 ft. from tip to tip.

In two photographs of California "scenery" presented to the National Museum by Mr. Chas. H. Townsend, Humpbacks are represented, showing the pectorals. (See pl. 40, fig. 4; pl. 41, fig. 5). One shows the under side of the left pectoral, which is white for the most part, but with black in the proximal fourth, and a narrow black posterior border, and black on the tubercles of the anterior border.

[1] This same form is shown in the photographic views of antarctic Humpbacks published by Racovitza in the cetology of the voyage of the *Belgica*, 1903.

There are two emarginations between the tubercle which marks the distal end of the radius and that which marks the ends of digit 2, showing that there are three phalanges in this digit as there are in *M. longimana*. Beyond the second digit there are at least five emarginations, as in the Atlantic species.

The second California photograph shows the upper side of the left pectoral of a Humpback and the flukes. The pectoral is nearly all black above, with irregular streaks of white distally and a white anterior border. There are two emarginations between the end of the radius and the end of digit 2, as in the last photograph and in *M. nodosa*, and about six emarginations beyond, as in that species. The flukes appear more or less white below.

The first California photograph also shows the peculiar outline of the inferior surface of the caudal peduncle characteristic of *M. nodosa*.

A skeleton from Pacific County, Washington, was exhibited in the World's Columbian Exposition in 1893. This specimen, according to a label attached to it, stranded at Long Beach, Pacific County, Washington, July 9, 1892. The length was 47½ feet and the girth 48 feet. The skeleton had the following vertebral formula: C. 7, D. 14, L. 11, Ca. 20 = 52. This same formula occurs in many specimens of *M. nodosa*, except that the caudals are usually 21. Seven chevron bones were present, and three more were apparently wanting to complete the series. The axis presented a complete ring on the right side, formed by the union of the diapophyses. The ring on the left side was nearly complete. The ribs were rounded on the outer edge distally and thin and sharp on the inner edge. The centra of the sixth and seventh dorsals were malformed and anchylosed together inferiorly.

There are in the National Museum several pieces of whalebone labelled as having been collected by Capt. Scammon on the Pacific coast. Two of these (No. 9791) were from a Humpback taken on the coast of California, November, 1869. Their length, without the bristles, is 18½ in., and the width at the base, 5½ in. The longest bristles measure 7¾ in. The blades are dull black, and the bristles also blackish at the base, changing to a dull faded brown toward the tip. Nos. 12263 and 12264 were obtained by Capt. Scammon at San Luis Obispo, California. These pieces are larger and thinner than the preceding and have a dull whitish surface with a metallic iridescence. I think there is no doubt they have been altered in color by immersion in poisonous fluid to destroy vermin. The larger plate, without the bristles, is 26 in. long, and 10½ in. wide at the base.

Gray, in 1866, gave the name *Megaptera kuriza* to the Humpback included by Temminck in the "Fauna Japonica" under the name of *Balæna antarctica* (*53*, 131). This was based on a Japanese drawing, and not on a specimen, and therefore has no validity as a species. The drawing is inaccurate in many particulars, but undoubtedly represents a *Megaptera*. So far as specific characters are concerned, it is not worthy of consideration. The matter is chiefly interesting as showing the occurrence of *Megaptera* on the coast of Japan. Of this Gervais, Möbius, and others have since given confirmation.

Those authors who, like Van Beneden, regard all the Humpbacks as belonging to one species, naturally assign this whale to *Megaptera longimana*, or *nodosa*.

Flower (1885) prefaces his list of specimens of *Megaptera* in the British Museum, which include a skull and other bones from California, with the following remark: "It is uncertain whether all the following specimens of *Megaptera* should be referred to one species or to several. If more than one, their distinctive characters have not been as yet clearly defined." (*46*, 5.)

Balænoptera velifera Cope. 1869.

Cope had no specimens on which to base this species, and named it from Scammon's description and sketches. (See p. 90.) The description is probably that given by Scammon in the article to which Cope's systematic synopsis forms the introduction (*83*, 52–53, figs. 9–10). From this Cope extracted the following characters (*83*, 16):

Color "shaded from the brown of the upper to the white of the lower surfaces."

Dorsal fin large; situated "at the commencement of the third fourth of the length from the head."

Baleen light lead-color, streaked with black, and its surface marked with transverse roughening.

The species is divided into two forms, a northern one with a large dorsal fin, and a southern one with a "very small fin." These forms, however, are not named.

Scammon's description is as follows:

"One picked up by Capt. Poole, of the bark 'Sarah Warren,' of San Francisco affords us the following memoranda: Length sixty-five feet. Thickness of blubber seven to nine inches. Yield of oil seventy-five barrels. Color of blubber a clear white. Top of head quite as flat and straight as that of the Humpback. Baleen, the longest two feet four inches, greatest width thirteen inches, its color a light lead streaked with black, and its surface presents a ridgy appearance crosswise; length of fringe to bone two to four inches, and in size this may be compared to a cambric needle.

"Its side fins and flukes are in like proportion to the body as in the California Gray. Its throat and breast are marked with deep creases or folds, like the Humpback. Color of back and sides black or blackish-brown; belly a milky white. Its back fin is placed nearer to the caudal than the hump on the Humpback, and in shape approaches to a right-angled triangle, but rounded on the forward edge, curved on the opposite one, and the longest side joins the back in some individuals; in others the anterior edge is the longest." (*83*, 52.)

Later in the same account Scammon states regarding one shot with a bomb-lance: "We got quite a good look at the under side of the whale . . . and our observations agreed with those noted on board the 'Sarah Warren' in relation to color of belly and the creases on throat and breast. The under side of the fins was white also."

Again he remarks:

"On the northern coast [of North America] the Finbacks, in many instances, have a much larger fin than those in warmer latitudes, and I am fully satisfied that these are a distinct species, confined to the northern waters. . . . Several [Finbacks] have been seen in May and June, on the coasts of California and Oregon, and in Fuca Strait in June and July of the present year [1868?]; these observations satisfy me that the dorsal fin of this, the northern species referred to, is strikingly larger than in the more southern Finbacks.

"Appended is a sketch of one individual of several seen in Queen Charlotte Sound in February, 1865, which is a fair representation of them all. Those I have noticed about Fuca Strait seem to have the back fin modified in size between the extremely small [one] found on [the coast of] Lower California and the one here represented."

The figures (Nos. 9 and 10) accompanying the article are quite crude, and, while they represent a Finback whale fairly well, are unreliable for critical comparisons. For example, in figure 9, which represents the *B. velifera* of the coast of California, the height of the dorsal fin is about 7 % of the total length. If this were correct, it would indicate a species with an enormous fin as compared with *B. physalus* of the North Atlantic, in which the height of the dorsal averages 2.3 % of the total length.

In fig. 10, which represents the northern form of *B. velifera*, the dorsal is given the increased proportion of about $8\frac{3}{4}$ % of the total length.

In these figures, furthermore, the shape of the pectoral fins, flukes, and "small" (or caudal) peduncle is unnatural, judging from photographs taken from fresh specimens of Atlantic Finbacks.

We hear no more of these Pacific Finbacks until Scammon published his great work on the Marine Mammals of the Northwestern Coast, in 1874. In this the description of 1869 is repeated with practically no alteration, but with the addition of measurements of "a *Balænoptera* which came on shore near the outer heads of the Golden Gate" (*82*, 34). Unfortunately these measurements are of very little importance, except that the total length—60 feet—is given. Reduced to percentages of the total length, Scammon's measurements, compared with the averages for Newfoundland specimens of *B. physalus*, are as follows[1]:

BALÆNOPTERA PHYSALUS (L.) AND *B. VELIFERA* COPE.

Measurement.	Newfoundland.	California.	Bering Id.
Total length	[average]	60 ft.	51.69 ft.
	%	%	%
Snout to eye	20.4	20.8	27.3
" " blowhole	18.3	....	22.9
" " post. base of dorsal	77.0	....	72.0
Height of dorsal	2.4	....	2.7
Breadth of flukes	22.4	23.3	....
Notch of flukes to vent	28.0	32.5	30.3

[1] Dr. L. Stejneger's measurements of a Finback found on Bering Id. are also included here for convenience. Further reference to them will be made later.

The agreement in two of the measurements is close, but the distance from the flukes to the vent is larger in Scammon's specimen. This may be a real difference, or may be due to measuring around the curve of the lower border of the caudal peduncle.

In connection with the text are given an outline figure of the northern Finback and a shaded figure of the southern form. The latter, with those of other species in the same work, are among the most beautiful delineations of whales that have ever been published, and there is no doubt of their general accuracy, though they would admit of some correction in details.

In the outline figure above mentioned, the dorsal fin is still represented as having a height of nearly 8 % of the total length, which must be regarded as an exaggeration. In the shaded figure of the southern Finback, the height of the dorsal fin is reduced to about 3 %, which is probably closer to the truth. On account of the discrepancies in these sketches and drawings, though produced by so competent an observer as Scammon, they can hardly be used in critical comparisons of species. Indeed, they can only serve to give us an approximate idea of the type of Finback Scammon had under observation. This is all the sketches profess to do.

Putting together the information to be derived from the descriptions and figures of 1869 and 1874, we determine that the species of Finback which Cope called *B. velifera*, is 60 to 65 feet long, black or blackish-brown on the back and sides, white on the belly and under side of the flippers; the dorsal fin falcate, moderately large, and situated at a point more than two thirds the distance from the end of the snout to the notch of the flukes; the whalebone short (longest 2 ft. 4 in.), light lead color, streaked with black, with bristles 2 to 4 inches long and thick as a "cambric needle"; flippers about 15.5 % of the total length, flukes about 23.3 % to 23.8 %.

If all these characters were to be considered as reliable, we might conclude that *B. velifera* represented a species intermediate between *B. physalus* and *B. musculus* of the North Atlantic. The moderate size, the white belly, the streaked whalebone, and anterior portion of the dorsal fin correspond with *B. physalus;* the large pectorals and broad flukes ally it to *B. musculus.* As, however, the sketches show discrepancies, the descriptions and measurements are meagre and more or less indefinite, nothing whatever is recorded regarding the skeleton, and there is no type-specimen, it is necessary to hold that the species was not completely characterized by Scammon and Cope, and that its real characters and affinities still remain to be elucidated. We may properly consider that what Scammon had in mind under the name of "the Finback," was the common moderate-sized Finback of the Pacific coast of the United States, and, if there are more than one, that which corresponds most closely to the *B. physalus* of the North Atlantic.

No material which passed through Scammon's hands, and which may be considered to represent *B. velifera*, is in the National Museum, except two pieces of whalebone, Nos. 13981 and 13982 U. S. N. M. These, according to the record, were obtained by Capt. Scammon near Tres Marias Ids., Mexico, in 1873. They are entered as "baleen of humpback whale." This is rather unfortunate as it

throws doubt on their authenticity, since they plainly belong to *Balænoptera* and not to *Megaptera*. However, the error is probably a clerical one.

The two pieces are thin and have the surface roughened by longitudinal and transverse raised lines. One piece (No. 13981) has a length of 23 in., and a breadth at the base of about 8.5 in. The second piece (No. 13982) is 28 in. long, with a breadth of 9.5 in. at the base. The former has two light-colored, translucent longitudinal bands, about $\frac{1}{2}$ in. wide, near the outer margin.

As no other material, representing this species, which passed through Scammon's hands, is now accessible, I have endeavored to find out what the "Common Finback" of the Pacific coast really is from other sources. The material at command is meagre and consists only of (1) a skeleton formerly owned by Cope and now in the museum of the Wistar Institute, Philadelphia (see pl. 6, fig. 4; pl. 28, figs. 5, 6); (2) measurements of a specimen captured off San Clemente Id., Cal., in 1895, and exhibited in Celoron, New York, in 1896.[1]

The Wistar Institute skeleton is that of an adult animal, which, according to a record on a piece of paper found in the box which contained the skeleton, was 68 ft. long. The mounted skeleton is 62 ft. 10 in. long. It is a very fine and practically perfect specimen. The whalebone is slate-colored, streaked longitudinally with whitish, and the right anterior 6 or 8 inches all white. This is characteristic of *B. physalus*. The vertebral formula is as follows: C. 7; D. 15; L. 15, Ca. 23 + = 60 +. The last caudal is about the size of an apple. There are fifteen chevron bones. The following measurements were taken with the aid of Dr. Greenman, to whom my best thanks are due:

SKELETON (MOUNTED) FROM WEST COAST OF NORTH AMERICA IN THE WISTAR INSTITUTE, PHILADELPHIA. (BELONGED TO COPE.)

Total length of skeleton, mounted	62 ft. 10 in.
Length of skull, straight, without premaxillæ	15 " $6\frac{1}{2}$ "
Breadth " " greatest	7 " 9 "
Length of rostrum, without premaxillæ	10 " $6\frac{1}{2}$ "
Breadth " " at middle	3 " $5\frac{1}{2}$ "
Length of mandible, straight	15 " 4 "
" " " curved	16 " 5 "
Breadth of orbit, least	$10\frac{3}{4}$ "
" " " greatest	20 "
Breadth of scapula	4 " 2 "
Height " "	2 " 7 "
Length of radius	2 " $9\frac{1}{2}$ "
" " ulna, least	2 " $6\frac{1}{2}$ "
" " " greatest	2 " $11\frac{1}{2}$ "
Breadth of axis	—
Depth of mandible at middle	1 " $1\frac{1}{2}$ "
Length of acromion of scapula, greatest	14 "
" " coronoid	$6\frac{3}{4}$ "

[1] For these measurements I am indebted to Prof. H. L. Osborn, St. Paul, Minn.

In the following table the measurements of the skull are reduced to percentages of its total length and compared with the average measurements of American *B. physalus* already given (p. 133):

BALÆNOPTERA PHYSALUS AND *B. VELIFERA?* SKULL.

Measurement.	East Coast *B. physalus*.	California skull.
Total length of skull	100 %	100 %
	%	%
Greatest breadth	47.1	48.0
Breadth of orbital border of frontal	10.6	10.3
Length of rostrum	67.2	69.1
Breadth of rostrum at middle	19.6	21.4
Length of mandible in straight line	93.9	94.8
Depth of mandible at the middle	6.7	7.0

The correspondence in proportions between the East and West Coast skulls is close, except that the California skull has a somewhat longer and broader beak than the average East Coast specimen. In these respects it is, however, below the maximum of *B. physalus*, as will be seen by consulting the table on p. 133.

It should be stated also that as the premaxillæ were not in place in the Cali-

FIG. 94.

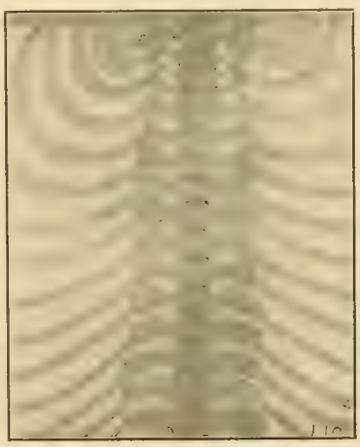


FIG. 95.

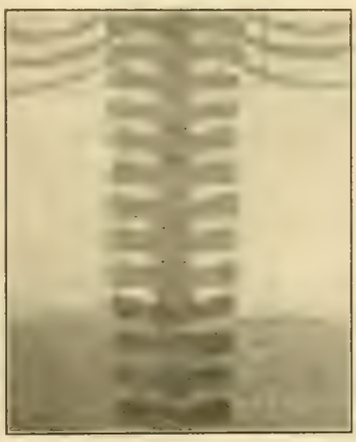


FIG. 96.

BALÆNOPTERA VELIFERA COPE? CALIFORNIA.

FIG. 94.—SKULL. FIG. 95.—CERVICAL AND DORSAL VERTEBRÆ. FIG. 96.—LUMBAR VERTEBRÆ. FROM BELOW. (WISTAR INSTITUTE, PHILADELPHIA.)

fornia skull when measured, an allowance had to be made for their extension beyond the maxillæ. This amount (7½ in.) may have been a trifle too great.

By reference to the measurements of Atlantic skeletons of *B. physalus* given on page 144, it will be found that the average breadth of the scapula is 26.4 % of the length of the skull, while in the California skeleton it is 26.0 %; the average depth of the scapula in the Atlantic skeletons is 15.9 % and in the California specimen

16.1 %. The length of the radius shows an equally close agreement—17.3 % in the Atlantic specimens, 17.5 % in the California skeleton.

All the bones of the California skeleton are rugged and massive, and there can be no doubt that it represents the adult state. The bony rings formed by the lateral processes of the axis are very broad; its neural arch and spine are low, but thick and quadrate in form. The neural spines of the cervicals and the first two dorsals are low and triangular, but farther back increase rapidly in size and become broad, high, and quadrate. The first four pairs of ribs are furnished with capitular processes, of which those of the second and third pairs are longest. The penultimate pair of ribs is shorter than the last pair, and both are much straighter than the preceding pairs. The first rib is short and flat, and broad at the free end.

The form of the sternum (see text fig. 32), though resembling in a general way that of adults of *B. physalus*, does not correspond exactly to the sternum of any specimen of that species thus far figured, as will be seen by consulting the figures on pages 140, 141. The anterior portion is broadly pentagonal, with an emarginate anterior border and a central vacuity. Attached posteriorly is a narrow segment, which near the middle of its length diminishes again in width rather abruptly.

The scapula has the outline characteristic of *B. physalus*, the superior margin quite straight, but bent down sharply behind, while the anterior margin makes an angle of about 45° with the plane of the edges of the glenoid fossa. The acromion is large and club-shaped (see text fig. 97; also pl. 7, fig. 3).

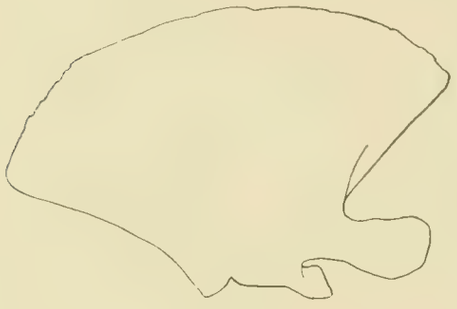


FIG. 97.

This skeleton is more noticeable for its agreement with *B. physalus* than for any distinguishing characters. The shape of the sternum, on the whole, presents the greatest difference, and in a part which varies so much as this the importance of this difference cannot be strongly insisted upon.

The measurements of the San Clemente Id. specimen, given below, are not as trustworthy as could be wished for, since it appears probable that the fins and other parts were more or less distorted by drying and other post-mortem changes.

They are as follows:

Total length from tip of mandible to tip of flukes	55 ft.	0 in.
Tip of snout to blowhole	8 "	2 "
Length of pectoral "from shoulder-joint"	5 "	4 "
Height of dorsal fin	0 "	11 "
Breadth of flukes	9 "	10 "
Notch of flukes to posterior base of dorsal	10 "	8 "
Tip of mandible to eye	12 "	6 "

Professor Osborn states that the whale, as preserved, was black, and quotes Capt. J. H. Hoe, who captured the specimen, to the effect that "the whalebone

was white in front and across the throat, with a white fringe on the entire roof of the mouth—the rest was jet black." This last statement would indicate that the whale was allied to *B. borealis*, but coming to me at second-hand, I do not know how much reliance to place upon it. Reducing the measurements above given to percentages of the distance from the notch of the flukes to the posterior margin of the dorsal fin, which seems likely to be the most reliable measurement, we have the following as compared with the Newfoundland specimen of *B. physalus* No. 7, which was of about equal size:

	Newfoundland specimen.	San Clemente Id. specimen.
	%	%
Distance from notch of flukes to posterior base of dorsal...	100.0	100.0
Tip of snout to blowhole.....	71.8	76.6
Length of pectoral from shoulder.....	50.0	53.4
Height of dorsal fin.....	8.6	10.8
Breadth of flukes.....	92.2	93.2

The approximation shown is interesting, but it is neither sufficiently close nor sufficiently remote to justify any positive assertions in the case.

It remains to mention the specimen examined by Dr. L. Stejneger on Bering Id. in 1882, which may be supposed to represent *B. velifera*. It was not a fresh specimen, having lain on the beach for a long time prior to Dr. Stejneger's visit. His description and measurements are given in the *Proceedings of the National Museum* (*85*, 74, 75). In a general way they agree with *B. physalus*, but the head is proportionately much shorter, and the dorsal fin farther forward (see p. 117). Dr. Stejneger remarks incidentally that the height of the dorsal fin was about $\frac{1}{30}$ the total length, which latter was $6\frac{1}{2}$ times the length of the pectorals. This would make the dorsal a little higher and the pectorals much longer than in *B. physalus*. In these respects there is an approach to the proportions of the San Clemente Id. specimen given above and to the proportions casually mentioned by Scammon, and it is possible that *B. velifera* is characterized by larger fins than *B. physalus*. A rigid comparison of measurements, however, is not feasible.[1]

Dr. Stejneger brought back three pieces of the whalebone of the Bering Id. specimen (14504 U. S. N. M.; original No. 1629). These are yellowish-white and grayish, and striped precisely as in *B. physalus*, from which they present no tangible differences. The three pieces are of the following dimensions respectively: (*a*) length, without bristles, 28 in., width at base $8\frac{1}{2}$ in.; (*b*) length 24 in., width $7\frac{1}{2}$ in. (probably much wider originally); (*c*) length 17 in., width 6 in. The smallest piece is almost entirely translucent yellowish-white, with but two prominent dark stripes, while the largest piece is nearly all dark and opaque in the deeper layers, though in part superficially overlaid with translucent light-colored layers.

In spite of various apparent deviations, I am of the opinion that the evidence

[1] For example, Dr. Stejneger states, as just mentioned, that the height of the dorsal fin was about $\frac{1}{30}$ the total length. In the table of measurements, however, the total length is given as 51.69 ft., while the height of the dorsal is 1.37 ft. or about $\frac{1}{38}$.

above given indicates that *B. velifera* does not differ at all from *B. physalus*, or in other words is identical with that species, except perhaps in the greater length of the pectorals. Even this difference is of doubtful validity as the remainder of the skeleton appears to coincide with *B. physalus*.

Much more material from the West Coast must be examined before the question can be settled.

Speaking of Scammon's work, Van Beneden remarks in 1889: "The *Balænoptera musculus* [= *B. physalus* (L.)] bears the name therein of *Balænoptera velifera*" (*7*, 155). He had probably never seen any specimens, however, and his opinion is no doubt based on the descriptions of Cope, Dall, and Scammon.

Balænoptera sulfureus (Cope).

This species was described by Cope in 1869 from data furnished by Scammon (see p. 90). His brief account was as follows:

"*Sibbaldius sulfureus* Cope.
"The Sulphur-Bottom of the North West Coast.
"This immense whale is as yet too insufficiently known to be distinguished as fully as desirable, but the marked peculiarity of coloration separates it from the only species with which a comparison is necessary—the *S. borealis* or *gigas* of the North Atlantic. Capt. Scammon describes it to be a gray or brown above, paler than on the *Balænoptera velifera*, and beneath, a sulphur yellow. Length from seventy to ninety feet. The colors of the *S. borealis* are described as polished black above, milky white beneath, by Dubar" (*83*, 20).

The characters given by Cope were undoubtedly drawn from the account given by Scammon in the latter part of the same article (*83*, 51). In this account the following points were mentioned regarding the species:

It is the largest whale on the coast of California.
Length approximately 70 to 90 feet.
Body more slender than in the California Gray whale.
Pectorals and flukes of the same proportions as in "the Finback" and the Gray whale.
Color on the back and sides somewhat lighter than in "the Finback," beneath of a yellowish cast, or sulphur color.
Dorsal fin much smaller than in "the Finback," and a little nearer the flukes.
Head, throat, and whalebone in shape like those of "the Finback."
Occurs at all seasons on the coast of California.
A specimen captured off St. Bartolme Bay in 1857 by the bark *Lagrange*, was 85 feet in length and yielded about 90 barrels of oil.

In 1870, in his article on *Megaptera bellicosa*, Prof. Cope added a description of the whalebone of the species, four laminæ of which had been sent to the Smithsonian Institution by Capt. Scammon. He summarizes the characters of the species as follows (*29*, 108):

"Dorsal fin small, conic, situated on the posterior fourth of the back. Form slender; length 70 to 90 feet. Color, above, gray or brown; below, sulphur yellow."

The whalebone is described as follows:

"Baleen black everywhere. Bristles intermediate in size between those of *Sibbaldius tectirostris* Cope (finer), and *Megaptera osphyia* (coarser), in 6 or 8 rows, and 7 or 8 inches in length. Length of plate, without bristles, 2 ft. 8 inches; width of base 18 inches. Laminæ with weak transverse rugosities" (*29*, 108).

In the Marine Mammals, Scammon did not add any information of importance, but changed the estimate of length from 70–90 ft. to 60–100 ft. He also includes the following data, furnished by Capt. Roys of the bark *Iceland*, of a Sulphur-bottom, presumably this species, taken by him at some locality not stated:

Length	95 ft.
Girth	39 "
Length of jawbone	21 "
Longest whalebone	4 "
Yield of whalebone	800 lbs.
Yield of oil	110 bbls.

From these several records, it is evident that *B. sulfureus* is a species allied to the *B. musculus* of the Atlantic. If there is any real basis for separation, it would appear to be in the color of the body, and possibly in the greater length of the whalebone. The latter is given as 4 feet in Capt. Roys's 95 ft. Pacific specimen, while the longest Newfoundland whalebone I could find was but 32 inches long, and the average only 24.7 in. It is possible of course that in the case of the Pacific specimen the bristles were included. As these are 1 ft. to 18 in. long they would make up a total length of 4 ft. or more. The total length of 95 feet is in excess of the largest reliable measurement for *B. musculus*, namely, 88 ft. 6 in., but taken alone this fact can not be given much weight.

Scammon published two figures of *B. sulfureus*, one a crude outline, in the article edited by Cope (*83*, fig. 11), and the other in the Marine Mammals (*82*, pl. 13). The latter is a finely shaded figure, beautifully proportioned. If it is accurate, *B. sulfureus*, we must believe, is quite different from *B. musculus* in color and proportions. The pectoral fin is represented as very broad and blunt, with an irregular anterior margin. The dorsal is very much reclined. The color is represented as very dark or black on the back, and white or very light on the entire lower half of the body, with a quite sharp demarkation from the dark color of the back. The anterior margin of the pectoral is dark. The pectoral folds are narrow at the posterior end and broad at the anterior end, and reach up very close to the margin of the lower lip in an absolutely regular succession. The caudal peduncle is very narrow at the insertion of the flukes.

In these particulars the figure is quite unlike *B. musculus*. The coloration, as represented, is more like that of *B. physalus*. The arrangement of the folds and the shape of the caudal peduncle are unlike any Finback whale with which I am acquainted. Unfortunately, the figure, like all the others in the book, appears to

have been "improved" by the lithographers. Scammon's rough outline figure does not help to understand the more elaborate one. While in general it resembles *B. musculus*, the folds, etc., are laid on in a very indifferent manner, so that exact comparisons are out of the question.

It is to be remarked that Scammon states that the color of the under surfaces of the body is "of a yellowish cast, or sulphur color." The Newfoundland Sulphur-bottoms which I examined were not of this color, though certain individuals, both of this species and of the common Finback, were more or less tinged with yellowish. This tinge was, however, purely an external manifestation, due either to an oily exudation from the skin, or to slime in the water or the oily matter in the food. The oily coating could be readily rubbed off, when the skin was seen to be gray. If the Pacific coast Sulphurbottoms are really furnished with a yellow pigment under the epidermis, this constitutes a difference from their Atlantic ally. I can not help feeling that the name Sulphurbottom had something to do with the assertion that the under surfaces of the body were sulphur color.

If Scammon really had an opportunity to see a specimen of *B. sulfureus* close at hand, it is very remarkable that he did not comment on the extraordinary mottled coloration, if the species is at all like *B. musculus* in that regard. We must believe, either that he never saw a specimen, or that the species is very differently colored from *B. musculus*, and therefore quite distinct. Considering that the whalebone is precisely like that of *B. musculus* in color and form, and that Scammon does not anywhere state definitely that he examined fresh specimens of the animal, the probabilities are in favor of a similarity rather than a diversity of color.

The whalebone which Prof. Cope mentions as having been received by the Smithsonian Institution from Capt. Scammon is not now to be found. There are, however, in the National Museum two pieces (Nos. 13984–5 U. S. N. M.) labelled as having been obtained by Capt. Scammon at Monterey, Cal., in 1873, and 8 pieces (No. 72692 U. S. N. M., Eth.) obtained from the Makah Indians, Neah Bay, Washington. These are all very thick and heavy, and entirely black, both blade and bristles. Of Capt. Scammon's specimens one, No. 13984, is 28½ in. long; the other, No. 13985, 27½ in. long. The longest of the Neah Bay pieces, No. 72692, is 30 in. long. The inner edges are broken and the width at the base in the original state cannot be given. There is no appreciable difference between this whalebone and that of the Sulphurbottoms taken at Newfoundland.

Since nothing is known of the osteology of this species and the present material is so scant, the questions concerning its identity can not now be satisfactorily determined.

Regarding this species Van Beneden wrote in 1889 (7, 259): "The American and English whalers often speak of a *Balænoptera* under the name of Sulphurbottom. . . . We have many reasons to believe that this Sulphurbottom is also a synonym of *B. Sibbaldii* [= *B. musculus* L.]. That which confirms us in this identification is the examination which we have had occasion to make at Vienna, of some baleen designated by this name by Capt. Charles Scammon and which Prof. Steindachner had himself brought from San Francisco."

Pechuel (*73*, p. 1188, fig. A. 6) has a figure to which he gives the name *Sibbaldius sulfureus*, but it does not appear to have been based on the examination of specimens. He remarks:

"I saw it singly or in pairs in the Pacific Ocean near the coast from Chili to California, but it is found also in the North Atlantic Ocean. The whalers are accustomed to hunt it under favorable conditions, but only a few proportionately are killed. We often gave chase to it but without any result, as the animals were too quick and too active."

Rhachianectes glaucus Cope.

The California Gray whale, Grayback, or Devilfish, though known to whalers for a considerable time, was first introduced to science by Cope in 1868, under the name of *Agaphelus glaucus*, on the basis of a set of whalebone in the museum of the Essex Institute, Salem, Mass. (See p. 80.) Later in the same year he described the exterior of the animal and the skull and other parts of the skeleton from notes furnished by Mr. W. H. Dall. The genus *Rhachianectes* was established in 1869, with the following exceedingly brief diagnosis:

Rhachianectes Cope.

"This genus is now first characterized. Its only known species I originally united with *Agaphelus* Cope, but the form of the scapula is so different that it must be distinguished. While that of *Agaphelus* is identical with that of *Balænoptera*, it is in the present genus like that of *Balæna*" (*83*, 15).

Cope's second article, published in 1868 (*26*, 226), contains Mr. W. H. Dall's notes on two specimens observed at Monterey, California. The following external characters are given:

No. 2.—"The lower jaw is 4 inches longer than the upper; the blow-holes are entirely concealed by 4 dermal plicæ. . . . On the vertebral line, for 14 feet from the caudal flukes, is a series of 18 ridges, like the teeth of a saw, which are altogether dermal in their character. . . . On each side of sulcus penis a mammary sulcus a few inches shorter. Color above and below, black, with a gray bloom like a plum."

Cope remarks:

"Two rough outlines accompany Capt. Dall's notes. Both represent the pectoral fin as rather elongate, not pointed, but rather broad at the extremity. A third sketch represents the inferior view, and in it we see two lines for grooves, one on each side of the median gular line. This feature, if existing, is interesting, as indicating a tendency to the plicæ of the finback whales."

The whalebone of specimen No. 1 is described as "light yellow."

In Scammon's article, published in 1869, is a more extensive description of the external characters, as follows:

"The California Gray is unlike other species of *Balæna* in its color, being of a mottled gray; some individuals, however, of both male and female, are nearly black. The jaw is curved downward from near the spoutholes to the 'nib end,' or snout, and is not so wide as that of the other species in proportion to the size of body. The length of the female is from 40 to 44 feet,[1] the fully grown varying but little in size; its greatest circumference 28 to 30 feet, its 'flukes' 30 inches in depth and 10 feet broad. It has no dorsal fin. Its pectorals are 6½ feet in length, and 2½ feet in width, tapering from near the middle toward the end, which is quite pointed.[2] It has a succession of ridges, crosswise along the back, from opposite the vent to the flukes.

"The coating of fat, or blubber, is 6 to 10 inches in thickness, and of a reddish cast. The average yield of oil of the female is 40 barrels. The whalebone, or 'baleen,' of which the longest is 14 to 16 inches, is of a light brown color, the grain very coarse; the hair or fringe on the bone, likewise, is much coarser and not so even as that of the Right whale or Humpback.

"The male may average 35 feet in length, but varies more in size than the female, and the average quantity of oil it produces may be reckoned at 25 barrels." (*83*, 40–41.)

This description was accompanied by two crude figures of the exterior, representing the animal as black, with nearly regular blotches of gray all over the body, without a dorsal fin or furrows on the throat, and with the dorsal line near the flukes broken by a series of rounded sinuosities.

The species was figured again by Scammon in his Marine Mammals, in 1874. Here it appears as gray, with a large amount of white irregularly scattered over the superior surfaces, as if snow had fallen on it. One short furrow is shown on the lower jaw and the dorsal outline is somewhat irregular.

The description which accompanies this figure contains the following characters, not given in the earlier one: "Under the throat are two longitudinal folds, which are about 15 inches apart and 6 feet in length. The eye, the ball of which is at least 4 inches in diameter, is situated about 5 inches above and 6 inches behind the angle of the mouth. The ear, which appears externally like a mere slit in the skin, 2½ inches in length, is about 18 inches behind the eye, and a little above it." (*82*, 20.)

Dall's and Scammon's descriptions agree well together, except that according

[1] "Forty-four feet, however, would be regarded as large, although some individuals have been taken that were much larger, and yielding sixty or seventy barrels of oil." (Note by Scammon.)

[2] "The size of flukes and fins usually varies but little in proportion to the whole." (Note by Scammon.)

to the former the baleen is "light yellow," while Scammon gives the color as "light brown." Van Beneden states that the baleen in the Vienna museum is pale in color like that of *B. acuto-rostrata*. Dall's sketch, according to Cope, showed the pectoral rounded at the tip, while Scammon states that it is pointed. Pechuel (*73*, 1186) described the color of this whale as variegated gray,—remarking that "many are entirely blotched; individuals entirely dark-colored are rarely seen." Pechuel's figure is very different from Scammon's, having a much rounder and thicker head, and no irregularities on the median line of the back, and no furrows on the throat. It is rather a crude figure, though interesting in many particulars.

Townsend's figure of a fœtal specimen 17 ft. long, published in 1886 (*90*) shows a distinct crest on the back, extending from the flukes nearly half-way to the head. The free margin is irregular in outline. Townsend remarks regarding it: "The young *Rhachianectes* just before birth has a narrow, irregular longitudinal ridge along the posterior part of the back, which I did not observe in the adult. It extends from about opposite the vent to the flukes and is interrupted in many places. This ridge probably corresponds to the series of transverse ridges along the back of the adult as described by Scammon."

It is somewhat remarkable that the ridge was not seen in the adult. It is interesting to note that the Japanese, who appear to know this whale under the name of *Kokujira*, recognize two forms, one of which has the crenate ridge on the back, while the other has not.[1] Scammon's statement that the ridges are transverse is extremely interesting, and this character deserves further investigation, as it is quite unlike anything found in other whales.

The two characteristic throat furrows are shown in Townsend's figure.

SIZE.

Dall calculated the length of the two specimens examined by him at Monterey at 51 ft. and 48 ft. respectively; the latter a male. Scammon gave the length of the females as from 40 to 44 ft., but remarked that the latter would be considered large; for the males he places the average at 35 ft., but states that they vary more in size than the females. In 1873, he gave measurements of a male 42 ft. long and stated that four other individuals were measured, ranging from 35 to 40 ft. A young male measured by Pechuel was 32 ft. long. Townsend in 1886 (*90*) published, as already mentioned, a figure of a fœtal specimen 17 ft. long, from a female "nearly 40 feet long." It would seem that one or the other of these measurements must be incorrect. The dimensions of different specimens are given by Scammon, Dall, and Pechuel, as follows:

[1] See MÖBIUS, Ueber den Fang und die Verwerthung der Walfische in Japan. *Beilage zu den Mitth. Sekt. Küsten- und Hochsee-Fischerei*, No. 7, July, 1894.

RHACHIANECTES GLAUCUS COPE. CALIFORNIA.

Measurement.	Monterey Bay, 1865. Male. Scammon.		Monterey. Male. Dall.		San Diego Bay. Male. Pechuel.	
	ft.	in.	ft.	in.	ft.	in.
Total length	42	0	48	0[1]	32	0
Snout to blowholes	6	0	4	9	8	0
" " corner of mouth	7	0	10	0[2]	.....	
" " eye	7	6	10	4[3]	.....	
" " pectorals	11	0	....		.....	
Notch of flukes to anus	12	0	14	6	.....	
" " " " genital orifice	16	8	16	6	.....	
Length of pectorals	6	6	6	0	5	0
Width " " "	2	10	.....		2	0
" " flukes	10	0	8	9	9	0
Circumference at point of pectorals	21	0	.....		.....	
Distance from pectorals to top of back	4	6	.....		.....	
" corner of mouth to top of head	2	6	.....		.....	
Length of blowholes	0	8	.....		.....	
Antero-posterior breadth of flukes	3	5	.....		.....	
Thickness of each lobe of flukes	0	9	.....		.....	
Depth of caudal peduncle at junction with flukes	1	6	.....		.....	
Lower jaw extends beyond the upper	....		0	4	.....	
Length of genital slit	....		1	6	.....	
From genital slit to line of pectorals	....		15	0	.....	
" line of pectorals to end of mandible	...		15	0	.....	
Length of exterior canthus of mouth	....		1	6	.....	
" from eye to margin of canthus	....		0	6	.....	
Width of mouth at canthus	....		4	0	.....	
Longest baleen	1	6	1	2	1	0
Width of largest baleen	0	9	.....		.....	
Length of largest bristles of baleen	0	5	.....		.....	

These measurements are so little in accord that new observations are very much to be desired.

WHALEBONE.

The larger portion of the whalebone of one side of the mouth, from a specimen taken at San Luis Obispo, Cal. (No. 23306, U. S. N. M.) was sent to the National Museum by Mr. C. H. Townsend. This whalebone is entirely yellowish-white, both blades and bristles, except at one end of the series. Here for a distance of about 8 inches the blades and bristles are dull chocolate-brown. The end-blades are entirely brown, the next have some white on the inner side, then follow a number brown on the outer edge only, and finally all white, like the majority of the series. The blades are very thick on the outer margin, with a rounded edge. The largest plates measure 18 in. in length without the bristles, and 6 in. at the base. The longest bristles measure 9½ in., and were perhaps originally a little longer.

OSTEOLOGICAL CHARACTERS.

The skeleton of *Rhachianectes* has been described in more or less detail by Dall (*26*, 226–227), Van Beneden (*6*), Malm (*67*) and Beddard (*2*, 168).

There is a skull in the National Museum (No. 13803) which Mr. Dall obtained

[1] From end of mandible. [2] From length of mouth. [3] From chin to eye.

at Monterey, Cal., and which belongs to one of the specimens described in 1868 (*26*, 226, 227); the British Museum contains a skeleton; and there is a skull in the museum of the California Academy of Sciences.

The vertebral formula in the British Museum skeleton, according to Beddard, is C. 7, D. 14, L. 14, Ca. 21 = 56. Dall's Monterey specimen No. 1 had the following: C. 7, D. 13, L. and Ca. 28 plus those concealed in the flukes.

SKULL.

The peculiarities of the skull can be best understood from the figures on pl. 47, which represent the Monterey specimen in the National Museum. This same skull was figured by Van Beneden in 1877 (*6*, 96), from photographs furnished him by the Museum. Most striking are the rugosities of the occipital, the large size of the nasals, the shortness of the nasal portion of the intermaxillæ, and their great depth anteriorly, the overlapping of the orbital process of the frontal by the proximal portion of the maxilla, and the strong tubercle on the posterior margin of the former. All these characters are seen equally as well developed in the skulls figured by Malm (*67*) as in the Monterey specimen.

These and many other characters stamp it as a very distinct form, approaching closely neither *Balæna* nor *Balænoptera*.

The following measurements are from the Monterey skull in the National Museum, and the data given by Malm (*67*, 17–37). I am not positive that I have interpreted all of Malm's measurements correctly.

RHACHIANECTES GLAUCUS COPE. SKULL.

Measurement.	No. 13803, U. S. N. M. Dall.	No. 51a Pitlekaj. Malm.	No. 53. Pitlekaj. Malm.	No. 52. Pitlekaj. Malm.	No. 54. Pitlekaj. Malm.	No. 34. Pitlekaj. Malm.
	mm.	mm.	mm.	mm.	mm.	mm.
Total length from the tip of premaxilla to occipital condyle (straight)	2464	....	....	....	....	....
Greatest breadth	1041	1040	820	830	840	....
Length of rostrum	1740	....	....	....	....	....
Breadth " " at base	584	....	....	....	....	....
" " " " middle	337[1]	....	....	....	....	....
" across premaxillæ at same point	184	....	....	....	....	....
Length of maxillæ from frontal border	1651	....	....	....	....	....
Greatest breadth across maxillæ proximally	851	....	....	....	....	...
Length of premaxillæ	2007	....	....	....	....	....
" " nasals in median line	305	....	....	....	....	300
Breadth of nasals at anterior end	171	....	....	....	....	155
Distance from anterior end of nasals to anterior end of supraoccipital	375	....	....	....	....	....
Length of orbit, point to point (least)	165	....	....	....	....	....
" " palatine bones	394[2]		330	....	....	...
Breadth across anterior and of zygomatic processes of squamosals	940	1000	790	750	....	....
Breadth across anterior angles of orbital processes of frontals	889	....	640	....	....	....
Breadth across posterior angles of orbital processes of frontals	991	....	710	....	...	....

[1] Straight. Around the curves = 866 mm.

[2] The exposed portion.

VERTEBRÆ.

Of the vertebræ, Beddard remarks (*2*, 168): "The atlas was missing; the remaining [cervical] vertebræ are quite independent of each other as in the Rorquals; and they have the wide lateral foramina formed by the transverse processes, which is so conspicuous a feature of those vertebræ in *Balænoptera* and *Megaptera*." Further than this the vertebræ have not been described.

STERNUM AND LIMBS.

The sternum is described by Beddard as "cross-shaped, but the arms of the cross very short, and the posterior termination almost a fine point."

According to Dall's notes, the scapula was in "breadth and height not very different, with a short, broad coronoid process, its head opposite first rib. Apparently only 4 fingers, of which the second is the longest."

Van Beneden remarked regarding this species in 1875: "It appears to us demonstrated and confirmed to-day . . . that the Devilfish of the American whalers is allied to the true whales by the absence of folds on the throat and of a dorsal fin, and by the presence of cirripeds and Cyami on the skin; and that it is allied to the Finbacks by the shortness of the baleen and the shape of the rostrum." "It is neither a *Balæna*, a *Balænoptera*, nor a *Megaptera*" (*5*, 36, 37).

Balænoptera davidsoni Scammon.

A nominal species which requires comparison with *B. acuto-rostrata* is the *B. davidsoni* of Scammon, described in 1872 (81). Scammon described this species again and figured it in his Marine Mammals (*82*, 49–51), and Mr. W. H. Dall noted it in the appendix to this work, and gave measurements of a skull in the museum of the California Academy of Sciences. Scammon's revised description is substantially the same as the original one. A comparison of this description with Sars's diagnosis and figure of *B. acuto-rostrata* indicates a close similarity.

Scammon states, however, that in his species the white marking of the pectoral is near the base. This is hardly true of *B. acuto-rostrata*, in which it may be said to be near the middle. Scammon's figure corresponds with his description in this particular, and shows the white band as very narrow, while in *B. acuto-rostrata* it occupies from one third to one half of the surface of the pectoral. If this distinction were constant it would, of course, have a certain importance. Unfortunately Scammon's description is not explicit on this point and his figure cannot be relied upon in detail. For example, the shape of the head is entirely unlike any Finback, and the lower lip is similarly incorrect. The same is true of the caudal region, the dorsal fin, and the flukes. If these characters were really as represented in the figure, it would be necessary to remove the species from the genus *Balænoptera*.

The skull, however (of which more will be said later), is indistinguishable generically, if not specifically, from *B. acuto-rostrata*. Nearly all the figures of whales in Scammon's work were evidently "improved" by the lithographers, with the result that they must be regarded as to a certain extent diagrammatic.

Scammon's measurements of *B. davidsoni*, show a very close agreement with those of Sir Wm. Turner's specimen from Granton, Scotland, except in the position of the dorsal fin. In Scammon's specimen the distance from the tip of the snout to the posterior margin of the dorsal fin is 66.6 % of the total length, while in the Granton specimen it is 70 %, and in other European specimens, from 71 % to 74 %. This difference would be of importance if substantiated, but a study of Scammon's measurements shows that it is due to an error. He states that the genital opening is slightly behind the anterior edge of the dorsal fin. We may presume, therefore, that the latter is about 6 in. in advance of the former, which is 9 ft. 6 in. from the notch of the flukes, or 17 ft. 6 in. from the tip of the snout. The anterior edge of the dorsal fin is, therefore, 17 feet from the tip of the snout, and as its base is 2 ft. 4 in. long, the posterior edge would be 19 ft. 4 in. from the tip of the snout, which is 71.6 % of the total length.

That this calculation is substantially correct is shown by the fact that in the fœtus from the same specimen, the measurements of which are given by Scammon, the distance of the posterior margin of the dorsal from the tip of the snout is 71.2 % of the total length. The dorsal fin in *B. davidsoni*, is, therefore, situated as in *B. acuto-rostrata.*

Mr. W. H. Dall, in the appendix to the Marine Mammals (*82*, 304, 305) gave the following measurements of a skull of unknown locality, presented to the museum of the California Academy of Sciences, by Mr. Merrill:

BALÆNOPTERA DAVIDSONI SCAMMON. SKULL.

	In. and tooths.
Length of skull in straight line	48.00
Breadth of condyles	4.50?
Breadth of ex-occipitals (to outer edge of suture)	17.00
Breadth of squamosals	27.00
Height of foramen magnum	2.00
Length of supra-occipital	13.00
Length of articular process of squamosal, antero-posterior	8.00
Length of orbital process of frontal, right to left	10.00
Breadth of orbital from curved border of maxillary to hinder edge of orbital process of frontal	9.00
Breadth of orbital at upper surface of outer end	6.50
Nasals, length	4.50
Nasals, breadth of the two at posterior end	1.00
Nasals, breadth of the two at anterior end	2.50
Length from curved border of maxillary to tip of beak	30.00
Length of maxillary	33.00
Projection of premaxillary beyond maxillary	1.50
Breadth of maxillaries at hinder end	6.00
Breadth of maxillaries across orbital processes	12.50
Breadth of beak at base (curved)	16.50
Breadth of beak at $\frac{1}{4}$ its length from base (curved)	12.00
Breadth of maxillary at $\frac{1}{4}$ its length from base (curved)	2.50
Breadth of premaxillary at same point (curved)	1.00
Breadth of beak at middle (curved)	9.00
Breadth of maxillary at middle (curved)	2.50
Breadth of premaxillary at middle (curved)	1.50

	In. and 100ths.
Breadth of beak at $\frac{3}{4}$ its length from base (curved)	6.00
Breadth of maxillary at $\frac{3}{4}$ its length from base (curved)	1.50
Breadth of premaxillary at $\frac{3}{4}$ its length from base (curved)	1.25
Length of lower jaw in a straight line	47.00
Height at coronoid process	6.00
Length from posterior end of condyle to coronoid process	7.50
Height of ramus at middle	4.00
Amount of curve	6.50
Length of otic bullæ	3.50

The osteological material of this species in the National Museum available for the study consists of (1) a skull from Puget Sound (Cat. No. 12177, U. S. N. M.), presented by Capt. C. M. Scammon about 1872, and very probably belonging to the individual from which the original description was drawn, and hence the type of the species; (2) a skull from St. Paul Id., Pribilof Group, Alaska (Cat. No. 61715, U. S. N. M.), collected by Mr. C. H. Townsend of the U. S. Fish Commission.

Measurements of these skulls, reduced to percentages of the total length, are given on page 197, with those of specimens of *B. acuto-rostrata*. It will be observed by reference to the measurements that the Pacific specimens agree in all but one or two of the proportions given with those from the Atlantic in the closest possible manner. In each proportion in which one of the Pacific skulls differs from the Atlantic ones, the other harmonizes with the latter, so that there cannot be said to be a constant difference in any of the proportions between the specimens from the two oceans. For convenience, the actual measurements of the two Pacific skulls, and of the Norway skull, No. 13877, are given below:

BALÆNOPTERA ACUTO-ROSTRATA LAC. AND *B. DAVIDSONI* SCAMMON. SKULL.

Measurement.[1]	13877, U. S. N. M. Norway.	12177, U. S. N. M. Type of *B. davidsoni*. Puget Sound.	61715, U. S. N. M. St. Paul, Id., Alaska.
	in.	in.	in.
Length of skull (condylo-premaxillary)	60.5	61.5	59.25[2]
" " beak	36.75	38.0	36.0[2]
" " maxilla	.....	.....	.....
" " premaxilla	45.5	45.25	44.5[2]
Ant. border foramen margin over vertex to tip of beak	63.0	64.0	60.5[2]
Ditto to upper border of occiput	17.0	17.0	16.0
Greatest breadth of skull	34.5	35.25	33.5
Breadth at base of beak	20.5	21.5	20.0
" " middle of beak	12.5	12.75	11.0
" " " " orbital border of frontals	31.5	32.75	30.5
Greatest breadth of maxilla behind base of beak	30.5	.....	29.5
" " between outer borders of both premaxillæ	8.25	9.5	8.25
" " " inner " " " "	5.5	6.5	6.0
From vomer at ant. end of palate through to vertex	13.75	15.5	14.75
Inner margin nasal processes of max. to end of orbital process of max.	17.75	19.25	17.75
Outer edge of premaxilla to end of orbital process of maxilla	16.0	16.0	15.5

[1] All straight, unless otherwise stated.

[2] Add 2 in. for breakage.

In spite of the correspondence in general proportions between two Pacific skulls and the Norway and Massachusetts skulls, my associates, Dr. L. Stejneger and Mr. G. S. Miller, Jr., who examined them with me, while side by side in one of the halls of the Museum, pointed out certain characters in which the two Atlantic skulls appeared to them to differ from the two Pacific skulls. The principal of these were (1) that the nasal processes of the maxillæ were bent toward the median line much more strongly in the Pacific than in the Atlantic skulls, and (2) that the orbital process of the maxillæ was shorter and thicker in the former than in the latter. The characters will be seen by comparing the figures on plates 22 and 23. I also noted that in the Pacific skulls the vomer appeared to descend more opposite the anterior end of the palatines, giving a stronger curve to the inferior profile of the cranium, and that the palatines were broader posteriorly. I have endeavored to bring out some of these differences in the last three measurements of the foregoing table. These measurements reduced to percentages of the total length of the skull are repeated below:

BALÆNOPTERA ACUTO-ROSTRATA LAC. AND *B. DAVIDSONI* SCAMMON. SKULL.

Measurement.	20931, U.S.N.M. Harwichport, Mass.	13877, U.S.N.M. Norway.	12177, U.S.N.M. Puget Sound.[1]	61715, U.S.N.M. St. Paul Id., Alaska.
	in.	in.	in.	in.
Total length of skull, straight	43.5	60.5	61.5	61.25[2]
	%	%	%	%
Distance from inferior surface of vomer at ant. end of palatines to vertex, straight	23.6	22.7	25.1	24.1
Inner edge of proximal end of nasal process of maxilla to distal end of orbital process of maxilla, straight	26.5	29.3	31.3	29.0
Outer edge of premaxilla to distal end of orbital process of maxilla, straight	23.6	26.5	26.0	25.3

It would appear from the foregoing that the vomer is deeper in the Pacific skulls, but the proportional length of the orbital process of the maxilla does not differ materially in the Norway and Pacific skulls. The breadth of this process, as shown by plates 22 and 23, is greater in the Pacific skulls than in the one from Norway. This greater breadth, however, is approximated in Eschricht's figure of an adult skull from Norway (*37*, pl. 9, fig. 1).

If any of these differences prove constant on examination of a larger number of specimens, it will probably be the greater depth of the vomer and the bending inward of the nasal process of the maxilla. As regards the latter, Eschricht's and Capellini's figures of European skulls present a substantial agreement with our skulls from Norway and Massachusetts.

[1] Type of *B. davidsoni*.

[2] 2 in. added for breakage.

A series of vertebræ belonging to a small Finback whale were found by me on St. Paul Id., Pribilof Group, Bering Sea, July 30, 1895. They were 27 in number, and included the 7th cervical, 11 dorsals, and 15 lumbars and caudals. It will be observed that the number of dorsals is the same as in *B. acuto-rostrata.*

Of this species Van Beneden remarked in 1889 (7, 165): "In our opinion it is a synonym of *Balænoptera rostrata*" (= *B. acuto-rostrata*).

CHAPTER X.

CONCLUSIONS.

The conclusions reached in the foregoing pages are:

(1) That the species of whalebone whales occurring in the western North Atlantic Ocean are identical with those occurring in the eastern North Atlantic.

(2) That these species are the Bowhead, or Greenland Right whale, *Balæna mysticetus*, the Black whale, *Balæna glacialis*, the Humpback, *Megaptera nodosa*, the Sulphurbottom, *Balænoptera musculus*, the common Finback, *Balænoptera physalus*, and the Little Piked whale, *Balænoptera acuto-rostrata*, and probably the Pollack whale, *Balænoptera borealis*.

(3) That the range of one of these whales—the Humpback—extends southward at least as far as 18° North Lat.

(4) That the probability of the identity of the North Pacific species with those of the North Atlantic is strengthened by the evidence herein collected.

As modifications of the preceding statements, several particulars require to be brought forward. Both the Little Piked whale and the Humpback of Greenland may possibly possess characters entitling them to be regarded as separate subspecies. These differences, however, are quite as likely to be due to inaccuracy of observation. As the species are migratory, it is probable that the Greenland individuals mingle with individuals from farther south and are identical with them both specifically and subspecifically, but additional evidence is needed to prove this hypothesis.

As no specimens of the Pollack whale, *Balænoptera borealis*, from American waters have been examined, it is not certain that the species is really the same on both sides of the Atlantic. As the other species are the same, the presumption is, of course, that the Pollack whale also undergoes no modification. This, however, requires to be demonstrated.

As evidence is strengthened regarding the specific identity of the whales of the North Atlantic and North Pacific, the belief that the same species of large whales range all over the globe is, of course, also strengthened. It is well-known that whales closely resembling *Megaptera nodosa*, *B. acuto-rostrata*, *B. musculus*, and *B. physalus*—to mention no others—occur in the South Atlantic and the Antarctic seas, and also—the second and last, at least—about New Zealand.

Some competent zoölogists have expressed the opinion that the species are cosmopolitan, but as already said in the case of the North American species, such opinions have not been based to any large extent on the critical examination of

considerable numbers of specimens from the regions mentioned. Such opinions have, of course, a certain interest and value, but knowledge will not be greatly increased without the study of new material.

Even should it be demonstrated that the species of large whalebone whales are cosmopolitan, it does not follow that the individuals constituting these several species range throughout the globe. The probabilities are much against such world-wide movements, and in the case of the Right whales it appears to have been demonstrated by Maury that individuals do not cross the equator. In this latter case, and perhaps in others, it would appear that the study of the migrations of separate groups of individuals, or schools, can be carried on profitably without regard to the general facts pertaining to the distribution of the species as a whole.

The following diagnoses of North Atlantic species are intended to summarize the observations of earlier writers both American and European, as well as those detailed in the preceding pages. The diagnosis of *Balænoptera borealis* is based on Collett's admirable account of that species (21).

Balæna glacialis Bonnaterre.

Black whale, Nordcaper, or Biscay whale. Plate 50, fig. 2.

Form massive. Head very large. Rostrum narrow and curved, with a protuberance near the anterior end ("bonnet"). Blowholes elevated and followed by a distinct depression. Lower lip very large, oblong, the free margin more or less sinuous.

Pectorals very broad, short, with a convex posterior margin and pointed tip.

Color black throughout, or with more or less white on the throat and breast in some individuals.

Rostrum of skull very long and narrow; the anterior half strongly curved. Intermaxillæ broad, occupying nearly the whole upper surface of the rostrum. Nasals very large, broad, oblong. The free anterior border w-shaped. Orbital process of frontal very narrow, somewhat tubular, and only moderately bent backward, the orbital border very narrow, oblique. Occiput broad, with convex sides.

Sternum broadly and irregularly triangular. Scapula broader than high; broad near the base. Vertebral formula: C. 7, D. 14, L. 11 (10-12), Ca. 23 (–26). Total 55 (–57).

Megaptera nodosa (Bonnaterre).

Humpback. Plate 50, fig. 1.

Form massive and peculiarly ungraceful, size moderate. Head flat and obtuse. Abdominal ridges few and broad, 14 to 30. Average total length, 48 feet; maximum, 55 feet.

Pectorals, from head of humerus, 32 per cent. of total length; lanceolate, with extremity recurved; anterior margin with ten or eleven very prominent sinuosities corresponding to the joints of the manus; posterior margin convex proximally, concave distally, with several small sinuosities at the extremity.

Dorsal low, thick at the base, erect or somewhat falcate, with the anterior margin usually concave near the middle.

Flukes broad, with convex anterior border, concave posterior border, and acuminate extremities; posterior border crenate.

Abdominal ridges converging in the median line below, anteriorly, forming an irregular projection below the symphysis of the mandible.

Inferior outline of the body from the pudendum posteriorly broken by three convexities, of which the largest and most salient is behind the anus. Head and lips with numerous low rounded tuberosities; three rows on the head, one median and two lateral; a large irregular aggregation at the symphysis of the mandible and others scattered along the rami. A semi-elliptical furrow above the base of the pectoral.

Color black, with white markings. Body black, with a varying number of white areas and markings on the lower surface, especially on the mandible, the abdominal ridges, and about the pudendum. Many of the smaller white markings, especially on the mandible, are in the form of complete or incomplete rings, or circular areas, and are due to barnacles. White markings occasionally on the upper jaw, behind the eye, and on the dorsal fin. Pectorals virtually all white on the upper surface, or with the basal one third to one half clouded with black; a narrow, irregular posterior border and the larger anterior sinuosities, when occupied by barnacles, black. Under surface entirely white. Flukes black above, with some white markings near the extremities; below, usually with a large white area on each side of the median line, bordered anteriorly and posteriorly with black.

Whalebone dull grayish black, with some more or less dull whitish plates on the right side anteriorly. Bristles dull grayish black; the matted mass somewhat varied in tint.

Skull very broad; rostrum obtuse, sides slightly convex. Outer margin of intermaxillæ sinuous. Nasals narrow, the anterior free margin acutely pointed. Orbital process of frontal triangular, very broad transversely; orbital margin narrow, oblique, the posterior angle extending out much farther than the anterior. Occiput narrow anteriorly. Coronoid process of mandible low. Vertebral formula: C. 7, D. 14, L. 11 (–10), Ca. 21. Total, 53 (–52).

Balænoptera musculus (L.).

Sulphurbottom. Plate 48, fig. 2.

Form massive; size very large. Head very broad and obtuse.

Average total length, 76 ft.; maximum, 89 feet. Pectorals, from head of humerus, 15 per cent. of the total length, falcate, obtusely pointed. Dorsal fin very small; its height about 1 per cent. of the total length; very variable in form, but usually more or less falcate; situated behind the line of the anus.

Color of the body mottled gray throughout; the proportion of light and dark tints varying greatly in different individuals; head a little darker and nearly uniform; body usually lightest at the shoulder and between the pectoral and navel; darkest

between the navel and anus; some entirely white spots on the posterior ends of the abdominal ridges.

Pectorals gray on the upper surface except at the tip, usually with some lighter blotches; white on the lower surface, anterior margin, and tip. Dorsal fin dark gray, usually with whitish center crossed by light vertical, curvilinear markings. Flukes gray above and below; the lower surface with fine light and dark gray lines running antero-posteriorly.

Whalebone entirely black.

Rostrum of the cranium very broad; free margin of maxillæ convex; nasals oblong, with truncated anterior margin. Vertebral formula: C. 7, D. 15 (–16), L. 14 (–16), Ca. 26 (–28). Total, 63–65.

Balænoptera physalus (L.).

Common Finback. Plate 48, fig. 1.

Form remarkably slender, size large. Head narrow and pointed.

Average total length, 59 feet; maximum, 81 or 84 feet (?).

Pectorals, from head of humerus, 12 per cent. of the total length, lanceolate, pointed. Dorsal fin moderate; its height about 2½ per cent. of the total length; more or less falcate; situated just posterior to line of anus.

Color of the body dark gray above, white below; the two colors merging by imperceptible gradations on the flanks. Coloration of the head not bilaterally symmetrical, there being more white on the right side than on the left, at least as far back as the pectoral; right ramus of the mandible white externally, and also the anterior third, or more, of the whalebone; left ramus of the mandible and left whalebone dark gray. Dorsal fin dark gray like the back. Pectorals gray on dorsal surface, white on ventral surface and anterior margin. Flukes dark gray above, white below, with gray posterior margin. Gray of the flanks extending obliquely downward and backward from the pectorals toward the flukes, but not reaching the inferior margin of the caudal peduncle, where there is a narrow white edge, bounded anteriorly by a linear gray mark directed obliquely forward and downward toward the anus.

Whalebone gray striped longitudinally with yellowish white in varying proportions; anterior whalebone on right side of body all yellowish white.

Rostrum of the skull narrow and acuminate; free margins of maxillæ nearly straight. Nasals narrow, and pointed anteriorly in the median line. Vertebral formula: C. 7, D., 15 (–16), L. 14 (–15), Ca. 25 (–26). Total, 61–63.

Balænoptera borealis Lesson.

Pollack whale. Plate 49, fig. 2.

Form moderately robust. Size moderate. Average total length, 46 to 47 feet; maximum, 54 feet. Pectorals, from axilla, 11 per cent. of total length, slender and pointed. Dorsal large, high, and falcate; vertical height about 4 per cent. of the total length; situated just anterior to the line of the anus.

"Color bluish black above, with oblong light colored spots; the underside as far as the genitalia more or less white. The whole of the tail, with the flukes and the flippers on both sides, is exactly similar to the back in color."

Whalebone plates, black; bristles, white.

Rostrum of the skull elongated and triangular with straight sides, as in *B. physalus*. Orbit very large. Nasals oblong and truncated anteriorly. Coronoid process of mandible low. Vertebral formula: C. 7, D. 14 (–13), L. 14 (–15), Ca. 20 (–21). Total, 55 (–56).

Balænoptera acuto-rostrata Lacépède.

Little Piked whale, or Lesser Finner. Plate 49, fig 1.

Form heavy, size small. Head narrow and pointed. Abdominal ridges numerous and narrow.

Average total length, 26 feet (?); maximum, 30 feet.

Pectorals, from axilla, 12.5 per cent. of total length, lanceolate, pointed. Dorsal fin large; its height about 5 per cent. of the total length; situated just in advance of the line of the anus.

Color of the body dark brownish gray above, white below, the two colors joining rather abruptly on the flanks; inferior margin of caudal peduncle white. Mandible dark gray. Dorsal fin dark like the back. Pectoral fins above with the middle third white, and tip and base dark gray; below similar, but with more white. Flukes gray above, white below. More or less gray mottling on the white abdominal ridges (?).

Whalebone all yellowish white.

Rostrum of cranium triangular, pointed, with straight sides. Orbital process of frontal large and oblong; orbit very large. Nasals large and triangular, the apex directed backward, the anterior free margin transverse or slightly convex. Vertebral formula: C. 7, D. 11, L. 12 (–13), Ca. 18 (–20). Total, 48 (–50).

APPENDIX I.

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APPENDIX II.

AMERICAN SPECIMENS OF WHALEBONE WHALES IN EUROPEAN MUSEUMS.

(Chiefly from Van Beneden, Flower, and Gray).

BALÆNA MYSTICETUS L.

Vienna, Austria.

1. Baleen from Bering Strait, collected by Captain Scammon. (Van Beneden.)

BALÆNA GLACIALIS (Bonn.).

Louvain, Belgium. (Museum of the University.)

1. Ear-bone of an adult, presented by Cope. (Van Beneden.)

Milan, Italy. (Civic Museum.)

1. Cast of one ear-bone of the type of *B. cisarctica.* (Gasco.)

MEGAPTERA NODOSA (Bonn.).

Bordeaux, France.

1. Fragments of skulls, jaws, pectoral elements, vertebræ, etc. From Martinique Id. (Van Beneden; see also Fischer, *7*, 58.)
2. Bones from Bermuda. (Van Beneden.)

Copenhagen, Denmark.

1. Skeletons of different ages from the East coast of Greenland, sent by Holböll to Eschricht. (Van Beneden.) (Many of these distributed to other European museums.)
2. Other specimens, viscera, fœtuses, etc. (Van Beneden.)

Brussels, Belgium. (Royal Museum.)

1. Skeleton from Greenland, received through Eschricht. (Van Beneden.)

Louvain, Belgium. (Museum of the University.)

1. Skeleton from Greenland, received through Eschricht. (Van Beneden.)

London, England. (British Museum.)

1. Complete skeleton, nearly adult, from Greenland. (Flower.)
2. Skull, with baleen, from Greenland. (Flower.)
3. Tympanic bones from Greenland. (Van Beneden.)
4. Fœtus from Greenland. (Flower.)
5. Skull and various bones from California. (Flower.)

Stockholm, Sweden. (Royal Museum.)

1. Numerous bones from St. Bartholomew Id., West Indies; received from Dr. Göes. (Van Beneden.)

Lund, Sweden.

1. Skeleton from Greenland; obtained from Eschricht. (Van Beneden.)

Leyden, Netherlands.

1. Skeleton received from Eschricht. (Van Beneden and Gervais.)

BALÆNOPTERA ACUTO-ROSTRATA Lac.

London, England. (British Museum.)
1. Skeleton from South Greenland. (Flower.)
2. Stuffed specimen, very young, from Greenland. (Flower.)

Louvain, Belgium. (Museum of the University.)
1. Skeleton from Greenland. (Van Beneden.)

Stuttgart, Germany.
1. Skeleton from Labrador. (Van Beneden.)

Copenhagen, Denmark.
1. (Eschricht states that Holböll transmitted three skeletons from Greenland. *Anat. Untersuch.*, p. 173.)
2. Seven fœtuses in alcohol. (Van Beneden.)

BALÆNOPTERA DAVIDSONI Scammon.

Vienna, Austria.
1. Baleen from San Francisco, Cal. (Van Beneden.)

BALÆNOPTERA PHYSALIS (L.).

Stuttgart, Germany.
1. Skull from the mouth of the Maroni River, Dutch Guiana; stranded in 1877. (Van Beneden.)

Copenhagen, Denmark.
1. Skeleton of an immature individual from Greenland, 53 ft. (N.) long. (Lilljeborg.)

BALÆNOPTERA MUSCULUS (L.).

Copenhagen, Denmark.
1. Bones of a pectoral fin, from Baffin Bay; collected by Holböll. (Van Beneden.)

St. Petersburg, Russia.
1. Skeleton from the Arctic Ocean. Collected by Peter Kargin, 1740. (Pallas; Van Beneden.) This species. ?

Vienna, Austria.
1. Baleen collected by Capt. Scammon. (Van Beneden.) This species. ?

RHACHIANECTES GLAUCUS Cope.

Vienna, Austria.
1. Baleen collected by Capt. Scammon. (Van Beneden.)

EXPLANATION OF PLATES.

PLATE 1.

FIGURE 1. Cranium of the type of *Sibbaldius tectirostris* Cope. Dorsal view. Philadelphia Academy of Natural Sciences.

FIGURE 2. Cranium of *Balænoptera physalus* (L.). Dorsal view. No. 16045, U. S. National Museum. Cape Cod, Mass. Collected by the U. S. Fish Commission.

FIGURE 3. Cranium of *Balænoptera physalus* (L.). Dorsal view. No. 16039, U. S. National Museum. Cape Cod, Mass. Collected by the U. S. Fish Commission.

PLATE 2.

FIGURE 1. Cranium of the type of *Sibbaldius tectirostris* Cope. Ventral view.

FIGURE 2. Cranium of *Balænoptera physalus* (L.). Ventral view. No. 16045, U. S. National Museum. Cape Cod, Mass.

FIGURE 3. Cranium of *Balænoptera physalus* (L.). Ventral view. No. 16039, U. S. National Museum. Cape Cod, Mass.

PLATE 3.

FIGURE 1. Cranium of *Balænoptera physalus* (L.). Dorsal view. Cape Cod, Mass. Ward's Natural Science Establishment, Rochester, N. Y.

FIGURE 2. The same. Ventral view.

FIGURE 3. The same. Lateral view.

PLATE 4.

FIGURE 1. Cranium of the type of *Sibbaldius tectirostris* Cope. Lateral view.

FIGURE 2. Cranium of *Balænoptera physalus* (L.). Lateral view. No. 16045, U. S. National Museum. Cape Cod, Mass.

FIGURE 3. Cranium of *Balænoptera physalus* (L.). Lateral view. No. 16039, U. S. National Museum. Cape Cod, Mass.

FIGURE 4. Bones from the type-skeleton of *Sibbaldius tectirostris* Cope. Right first rib (double-headed), first lumbar, first dorsal, and axis.

PLATE 5.

FIGURE 1. Cervical and dorsal vertebræ of the type-skeleton of *Sibbaldius tectirostris* Cope.

FIGURE 2. Lumbar vertebræ of the same.

FIGURES 3 and 4. Caudal vertebræ of the same.

PLATE 6.

FIGURE 1. Ribs of the type-skeleton of *Sibbaldius tectirostris* Cope.

FIGURE 2. Left scapula and humerus of the same.

FIGURE 3. Right first rib of the same (double-headed).

FIGURE 4. Anterior portion of the skeleton of *Balænoptera velifera* (?), from behind, showing the ribs, sternum, etc., in position. Coast of California. Wistar Institute, University of Pennsylvania.

PLATE 7.

FIGURE 1. Scapula of *Balænoptera physalus* (L.) from skeleton No. 16039, U. S. National Museum. Cape Cod, Mass.
FIGURE 2. The same from skeleton No. 16045, U. S. National Museum. Cape Cod, Mass.
FIGURE 3. Scapula from skeleton of *Balænoptera velifera* (?) in Wistar Institute. Coast of California.
FIGURE 4. Sternum of *Balænoptera physalus* (L.) from skeleton No. 16045, U. S. National Museum.
FIGURE 5. Scapula of *Balænoptera musculus* (L.). Balena Station, Hermitage Bay, Newfoundland.
FIGURE 6. Scapula from skeleton of *Balænoptera musculus* (L.). Ocean City, N. J. Philadelphia Academy of Natural Sciences.
FIGURE 7. Radius and ulna from the same.
FIGURE 8. Humerus from the same.
FIGURE 9. Ulna of *Balænoptera musculus* (L.). Balena Station, Hermitage Bay, Newfoundland.
FIGURE 10. Nasals of the same.

PLATE 8.

FIGURE 1. *Balænoptera physalus* (L.). No. 7 ♀. Showing dark left lip and the pectoral ridges. (The dark line crossing the white ridges obliquely is due to slime from the surface of the water.)
FIGURE 2. The same species. No. 18 ♀.
FIGURE 3. The same species. No. 9 ♂. Showing greater extension of dark color on the left side than in the preceding specimens.
FIGURE 4. The same species. No. 13 ♂.
All specimens from Snook's Arm Station, Notre Dame Bay, Newfoundland.

PLATE 9.

FIGURE 1. *Balænoptera physalus* (L.). No. 7 ♀. Ventral view.
FIGURE 2. The same species. No. 4 ♀. Ventral view, showing the enlarged mammary glands which appear as large rounded eminences immediately in front of the pudendum.
FIGURE 3. The same species. No. 20 ♀. Ventral view, showing the white right lip.
FIGURE 4. The same species. No. 2 ♀. Anterior portion of ventral surface, showing large extension of dark color.
FIGURE 5. The same species. No. 17 ♂. Dorsal view, showing right eye, auricular orifice, "corner of mouth," and pectoral.
All specimens from Snook's Arm Station, Notre Dame Bay, Newfoundland.

PLATE 10.

FIGURE 1. *Balænoptera physalus* (L.). No. 20 ♀. Head, showing white right mandible, anterior portion of upper jaw, and whalebone.
FIGURE 2. The same species. No. 9 ♂. Head, showing dark left jaws and whalebone.
FIGURE 3. The same species. No. 17 ♂. Lateral view of anterior portion of body, showing white right mandible, and the peculiar markings above the eye and at the base of the pectoral.
FIGURE 4. The same species. No. 18 ♀. Pudendum, mammary fossæ, and anus. *a*. clitoris, *b*. mammary fossæ, *c*. vestibule, *d*. anus, *e*. gray anal lines.
FIGURE 5. The same species. No. 9 ♂. Ventral view.
All specimens from Snook's Arm Station, Notre Dame Bay, Newfoundland.

PLATE 11.

FIGURE 1. *Balænoptera physalus* (L.). No. 12 ♂. Dorsal view (head lying in the water). Showing the right white mandible, and the peculiar markings above the eye, auricular orifice, and base of pectoral.
FIGURE 2. The same species. No. 13 ♂. Showing similar markings on the left side.
FIGURE 3. The same species. No. 18 ♀. Head. Dorsal view.
FIGURE 4. The same species. No. 7 ♀. Dorsal view.
FIGURE 5. The same species. No. 18 ♀. Dorsal fin. (The peculiar markings are due to abrasion by the cables.)
FIGURE 6. The same species. No. 18 ♀. Showing the whalebone in position and the "roof of the mouth." (The mandible has not been removed).
All specimens from Snook's Arm Station, Notre Dame Bay, Newfoundland.

PLATE 12.

FIGURE 1. *Balænoptera physalus* (L.). Provincetown, Mass. Length reported as 65 ft. 4 in., and "the largest of the finback species ever taken here" (Provincetown).
FIGURE 2. The same specimen. Ventral view. (The flukes are an addition by the photographer.)
FIGURE 3. The same species. Showing the mouth. Provincetown, Mass.
FIGURE 4. Another view of the same specimen.
FIGURE 5. The same specimen as Figure 3, showing flukes, penis, etc.
FIGURE 6. Stripping a carcass of *Balænoptera physalus* (L.) at Nantucket, Mass. Showing the white anterior right whalebone.
FIGURE 7. Flukes of *Balænoptera physalus* (L.), No. 26 ♂. Ventral surface. Snook's Arm Station, Notre Dame Bay, Newfoundland.
FIGURE 8. Flukes of *Balænoptera physalus* (L.), No. 25 ♂. Ventral surface. Snook's Arm Station, Notre Dame Bay, Newfoundland.

PLATE 13.

FIGURE 1. *Balænoptera musculus* (L.), No. 2 ♂. Anterior portion of body. Dorsal view, showing broad head, light mottled color of shoulder, and white extremity of pectoral.
FIGURE 2. The same species. No. 3 ♀. Pectoral region, showing mottled coloration, auricular orifice, eye, and pectoral.
FIGURE 3. The same species. No. 23 ♀. Lateral view of anterior half of body.
FIGURE 4. The same species and specimen. Lateral view.
All specimens from Balena Station, Hermitage Bay, Newfoundland.

PLATE 14.

FIGURE 1. *Balænoptera musculus* (L.), No. 9 ♀. Dorsal view.
FIGURE 2. The same species. No. 21 ♀. Lateral view.
FIGURE 3. The same species. No. 10 ♂. Ventral view.
FIGURE 4. The same species. No. 2 ♂. Ventral view.
FIGURE 5. The same species. No. 8 ♀. Ventral view.
FIGURE 6. The same species. No. 21 ♀. Ventral view.
FIGURE 7. The same species. No. 6 ♂. Dorsal view of anterior half of body.
All specimens from Balena Station, Hermitage Bay, Newfoundland.

PLATE 15.

FIGURE 1. *Balænoptera musculus* (L.). No. 3 ♀. Head, showing tongue and whalebone in position.
FIGURE 2. The same species. No. 6 ♂. Showing whalebone in position.
FIGURE 3. The same species. No. 23 ♀. Lateral view of head. (The mandible is probably in the position it has in life.)
FIGURE 4. The same species. No. 23 ♀. Anterior view of head. The blowhole appears at the summit of the broad head, and the eyes at the lateral extremities. (The mandible is out of position and exaggerated in size.)
All specimens from Balena Station, Hermitage Bay, Newfoundland.

PLATE 16.

FIGURE 1. *Balænoptera musculus* (L.). No. 23 ♀. Right eye and "corner of mouth."
FIGURE 2. Left eye of the same specimen.
FIGURE 3. The same species. No. 9 ♀. Whalebone and "roof of mouth."
FIGURE 4. The same species. No. 14 ♀. Left whalebone in position.
All specimens from Balena Station, Hermitage Bay, Newfoundland.

PLATE 17.

FIGURE 1. *Balænoptera musculus* (L.). No. 26 ♀. Ventral view, showing navel, pudendum, and scattered spots of light gray.
FIGURE 2. The same species, No. 20 ♀. Ventral view, showing a large amount of light color at the posterior ends of the abdominal ridges.
FIGURE 3. The same species, No. 26 ♀ (already shown in Figure 1). The dark coloration and paucity of spots are especially noticeable.
FIGURE 4. The same species, No. 20 ♀ (already shown in Figure 2). Shows the distinct white spots on the abdominal ridges and white area at base of pectoral.
Both specimens are from Balena Station, Hermitage Bay, Newfoundland.

PLATE 18.

FIGURE 1. *Balænoptera musculus* (L.). No. 5 ♂. Ventral view, showing small amount of light color on the abdominal ridges.
FIGURE 2. The same species. No. 21 ♀. Ventral view, showing large area of whitish color on the abdominal ridges.
FIGURE 3. The same species. No. 9 ♀. Ventral view, showing large amount of light color on the abdominal ridges.
FIGURE 4. The same species. No. 9 ♀. Showing the profuse light spots on the belly.
All specimens from Balena Station, Hermitage Bay, Newfoundland.

PLATE 19.

FIGURE 1. *Balænoptera musculus* (L.). No. 7 ♂. Ventral view, showing small amount of light color on the abdominal ridges.
FIGURE 2. The same species. No. 8 ♀. Navel region.
FIGURE 3. The same species. No. 23 ♀. Lateral view of the mammary fossæ and pudendum, showing the slight projection of these parts.
FIGURE 4. The same species. Piece of skin from the flanks, showing mottled coloration.
All specimens from Balena Station, Hermitage Bay, Newfoundland.

PLATE 20.

FIGURE 1. *Balænoptera musculus* (L.). No. 8 ♀. Pudendum, mammary fossæ, and anus. (The mammæ are in the furrows which are intermediate between the median line and the external furrows.)
FIGURE 2. The same species. No. 21 ♀. Pudendum, mammary fossæ, and anus; for comparison with preceding figure. (The mammæ are in the long furrow nearest the median line on each side): *a*. clitoris; *b*. mammary fossa; *c*. orifice of vagina; *d*. anus.
FIGURE 3. The same species. No. 11 ♂. Orifice of penis sheath and mammary fossæ containing rudimentary mammæ: *a*. orifice of penis sheath; *b*. mammary fossæ.
FIGURE 4. The same species. No. 15 ♂. Ventral view, showing (*a*) penis sheath; (*b*) mammary fossæ, and (*c*) anus.
All specimens from Balena Station, Hermitage Bay, Newfoundland.

PLATE 21.

FIGURE 1. *Balænoptera musculus* (L.). No. 8 ♀. Pectoral fin, showing abnormal extremity. Dorsal view.
FIGURE 2. The same. Ventral view.
FIGURE 3. The same species. No. 21 ♀. Left pectoral.
FIGURE 4. The same species. No. 7 ♂. Left pectoral, showing incised extremity.
FIGURE 5. The same species. No. 4 ♀. Left pectoral.
All specimens from Balena Station, Hermitage Bay, Newfoundland.

PLATE 22.

FIGURE 1. *Balænoptera acuto-rostrata* Lacépède. No. 20931, U. S. National Museum. Off Monomoy Point, Harwichport, Mass. Young. Dorsal view.
FIGURE 2. The same species. No. 13877, U. S. National Museum. Coast of Norway. Adult. Dorsal view.

PLATE 23.

FIGURE 1. *Balænoptera davidsoni* Scammon. Type-skull. No. 12177, U. S. National Museum. Admiralty Inlet, Puget Sound, Washington. Dorsal view.
FIGURE 2. The same species. No. 61715, U. S. National Museum. St. Paul Island, Pribilof Group, Bering Sea. Dorsal view.

PLATE 24.

FIGURE 1. *Balænoptera acuto-rostrata* Lacépède. No. 20931, U. S. National Museum. Off Monomoy Point, Harwichport, Mass. Young. Ventral view.
FIGURE 2. The same species. No. 13877, U. S. National Museum. Coast of Norway. Adult. Ventral view.

PLATE 25.

FIGURE 1. *Balænoptera davidsoni* Scammon. Type-skull. No. 12177, U. S. National Museum. Admiralty Inlet, Puget Sound, Washington. Ventral view.
FIGURE 2. The same species. No. 61715, U. S. National Museum. St. Paul Island, Pribilof Group, Bering Sea. Ventral view.

PLATE 26.

FIGURE 1. *Balænoptera davidsoni* Scammon. Type-skull. No. 12177, U. S. National Museum. Admiralty Inlet, Puget Sound, Washington. Lateral view.

FIGURE 2. *Balænoptera acuto-rostrata* Lacépède. No. 20931, U. S. National Museum. Off Monomoy Point, Harwichport, Mass. Young. Lateral view.

FIGURE 3. The same species. No. 13877, U. S. National Museum. Coast of Norway. Lateral view.

PLATE 27.

FIGURE 1. *Balænoptera davidsoni* Scammon. No. 61715, U. S. National Museum. St. Paul Island, Pribilof Group, Bering Sea. Lateral view.

FIGURE 2. *Balænoptera acuto-rostrata* Lacépède. No. 20931, U. S. National Museum. Off Monomoy Point, Harwichport, Mass. Young. Lateral view.

FIGURE 3. The same species. Right scapula of skeleton No. 13877, U. S. National Museum. Coast of Norway. Adult.

FIGURE 4. The same species. Scapula of skeleton No. 20931, U. S. National Museum. Off Monomoy Point, Harwichport, Mass. Young.

FIGURE 5. The same species. Sternum of skeleton No. 13877, U. S. National Museum. Coast of Norway. Adult.

FIGURE 6. The same species. Sternum of skeleton No. 20931, U. S. National Museum. Off Monomoy Point, Harwichport, Mass.

PLATE 28.

FIGURE 1. *Balænoptera davidsoni* Scammon. Valdes, Alaska. Ventral view. Photographed by F. C. Schroeder, U. S. Geological Survey.

FIGURE 2. The same specimen. Dorsal view.

FIGURE 3. *Balænoptera acuto-rostrata* Lacépède. Quoddy Head, Maine. Ventral view.

FIGURE 4. The same specimen. Lateral view.

FIGURE 5. *Balænoptera velifera* (?). Anterior portion of skeleton in Wistar Institute, University of Pennsylvania. Coast of California.

FIGURE 6. The same, showing cervical and anterior dorsal vertebræ.

PLATE 29.

FIGURE 1. *Megaptera bellicosa* Cope. Type-skull. San Domingo or St. Barthlomew Island, West Indies. Philadelphia Academy of Natural Sciences. Dorsal view.

FIGURE 2. *Megaptera nodosa* (Bonnaterre). No. 21492, U. S. National Museum. Cape Cod, Mass. Dorsal view.

PLATE 30.

FIGURE 1. *Megaptera bellicosa* Cope. Type-skull. Ventral view.

FIGURE 2. *Megaptera nodosa* (Bonnaterre). No. 21492, U. S. National Museum. Cape Cod, Mass. Ventral view.

PLATE 31.

FIGURE 1. *Megaptera bellicosa* Cope. Type-skull. Lateral view.

FIGURE 2. *Megaptera nodosa* (Bonnaterre). No. 21492, U. S. National Museum. Cape Cod, Mass. Lateral view.

FIGURE 3. The same species. Cape Cod, Mass. Milwaukee Public Museum. Lateral view.

PLATE 32.

FIGURE 1. *Megaptera nodosa* (Bonnaterre). No. $\frac{16852}{13656}$, ♀, U. S. National Museum. Provincetown, Mass. Young. Dorsal view.

FIGURE 2. The same species. Cape Cod, Mass. Milwaukee Public Museum. Dorsal view. (The figure is much distorted.)

PLATE 33.

FIGURE 1. *Megaptera nodosa* (Bonnaterre). No. $\frac{16852}{13656}$, ♀, U. S. National Museum. Provincetown, Mass. Young. Ventral view.

FIGURE 2. The same species. Cape Cod, Mass. Milwaukee Public Museum. Ventral view.

PLATE 34.

FIGURE 1. *Megaptera bellicosa* Cope. Type-skeleton. Cervical and dorsal vertebræ.
FIGURE 2. The same specimen. Lumbar vertebræ.
FIGURE 3. The same specimen. Caudal vertebræ.
FIGURE 4. The same specimen. Right scapula, humerus, radius, and ulna.

PLATE 35.

FIGURE 1. *Megaptera bellicosa* Cope. Type-skeleton. First lumbar, first dorsal, axis, and atlas. Anterior view.
FIGURE 2. The same specimen. Ribs.

PLATE 36.

FIGURE 1. *Megaptera osphyia* Cope. Skull from the type-skeleton. Niagara Falls Museum, New York. (This type is in such a position in the museum that it is impossible to obtain an entirely satisfactory photograph. In this figure the anterior extremity of the rostrum and mandible have been added in pencil.)
FIGURE 2. The same specimen, showing artificial arrangement of phalanges.
FIGURE 3. The same specimen. Pectoral region. The vertebræ are mounted backwards.
FIGURE 4. *Megaptera nodosa* (Bonnaterre). Right scapula of No. $\frac{16252}{13656}$, ♀, U. S. National Museum. Provincetown, Mass. Young. Exterior view.
FIGURE 5. The same species, No. 21492, U. S. National Museum. Cape Cod, Mass. Exterior view.

PLATE 37.

FIGURE 1. *Megaptera nodosa* (Bonnaterre). No. 5 ♂. Showing white pectorals and under surface of flukes. Snook's Arm Station, Notre Dame Bay, Newfoundland.
FIGURE 2. The same specimen. Ventral view.
FIGURE 3. The same specimen. Head, showing white areas under the eye and at tip of snout, and white rings on the mandible caused by barnacles.

PLATE 38.

FIGURE 1. *Megaptera nodosa* (Bonnaterre). An unusually white specimen.
FIGURE 2. The same species.
From negatives taken by William Palmer at Balena Station, Newfoundland, 1901.

PLATE 39.

FIGURE 1. *Megaptera nodosa* (Bonnaterre). No. 5 ♂. Ventral view, showing characteristic arrangement of ridges anteriorly.
FIGURE 2. The same species. No. 6 ♀. Dorsal view.
FIGURE 3. The same species and specimen. Ventral view, showing small amount of white on exterior surface of the pectoral, and on the belly.
FIGURE 4. The same species. No. 21 ♀. Ventral view.
All specimens from Snook's Arm Station, Notre Dame Bay, Newfoundland.

PLATE 40.

FIGURE 1. *Megaptera nodosa* (Bonnaterre). Provincetown, Mass. Male. Ventral view.
FIGURE 2. The same species. Flukes from No. 13656, ♀, U. S. National Museum. Provincetown, Mass. Dorsal view.
FIGURE 3. The same species. No. 21 ♀. Snook's Arm Station, Newfoundland.
FIGURE 4. *Megaptera versabilis* Cope. Coast of California. Photograph obtained by Mr. C. H. Townsend.

PLATE 41.

FIGURE 1. *Megaptera versabilis* Cope. Henderson's Bay, Puget Sound, Washington, September 5, 1896. Shows the arrangement of dermal tubercles, shape of blowholes, color of pectoral fin, etc.
FIGURE 2. The same specimen.
FIGURE 3. The same specimen. Head and back, showing characteristic shape of dorsal fin, dermal tubercles, etc.
FIGURE 4. The same specimen. Mouth.
FIGURE 5. The same species. Coast of California. Photograph obtained by Mr. C. H. Townsend.
FIGURE 6. Right pectoral of *Megaptera nodosa*. No. 13656, ♀, U. S. National Museum. Provincetown, Mass. Exterior surface.

PLATE 42.

FIGURE 1. *Balæna glacialis* Bonnaterre. Skull from skeleton No. 23077, U. S. National Museum. Long Island, New York. Dorsal view.

FIGURE 2. The same specimen. Ventral view.

PLATE 43.

FIGURE 1. *Balæna glacialis* Bonnaterre. Skull from skeleton No. 23077, U. S. National Museum. Long Island, New York. Lateral view.

FIGURE 2. The same species. Skull from skeleton in State Museum, Raleigh, North Carolina. Cape Lookout, N. C. Lateral view. Photograph presented by Mr. H. H. Brimley, Curator of the State Museum.

PLATE 44.

FIGURE 1. *Balæna cisarctica* Cope. Type-skeleton. Philadelphia Academy of Natural Sciences. Lateral view of anterior portion, including the lumbar vertebræ.

FIGURE 2. The same specimen. Lateral view of the caudal vertebræ.

PLATE 45.

FIGURE 1. *Balæna glacialis* Bonnaterre. Skull from skeleton in Charleston College Museum, South Carolina. Charleston, S. C. Lateral view.

FIGURE 2. The same species. Left scapula from the same skeleton.

FIGURE 3. The same species. Left scapula from skeleton in American Museum of Natural History, New York. From Long Island (?), New York. Photograph presented by Dr. H. C. Bumpus, Director of the American Museum of Natural History.

FIGURE 4. The same species. Left scapula from skeleton in Field Columbian Museum, Chicago. Long Island, New York. Photograph presented by Dr. D. G. Elliot, Curator of Mammals, Field Columbian Museum,

FIGURE 5. The same species. Left scapula from skeleton No. 23077, U. S. National Museum. Long Island, New York.

PLATE 46.

FIGURE 1. *Balæna glacialis* Bonnaterre. Head of specimen found dead 28 miles off Highland, Cape Cod, April, 1895. Photographed in Herring Cove, Provincetown, Mass.

FIGURE 2. The same specimen. Lateral view. (The flukes are an addition by the photographer.)

FIGURE 3. The same species. Sternum from skeleton in Field Columbian Museum, Chicago. Long Island, New York. Photograph presented by Dr. D. G. Elliot, Curator of Mammals, Field Columbian Museum.

FIGURE 4. The same species. Sternum from skeleton in Museum of Comparative Zoölogy, Harvard University. Photograph presented by Mr. Outram Bangs, Curator of Mammals.

PLATE 47.

FIGURE 1. *Rhachianectes glaucus* Cope. No. 13803, U. S. National Museum. Monterey, Cal. Dorsal view.

FIGURE 2. The same specimen. Ventral view.

FIGURE 3. The same specimen. Lateral view.

PLATE 48.

FIGURE 1. Common Finback. *Balænoptera physalus* (L.). Restoration, based on Sars's figures, amended from photographs and sketches of Newfoundland specimens.

FIGURE 2. Sulphurbottom, *Balænoptera musculus* (L.). Restoration, prepared in the same manner as Figure 1.

PLATE 49.

FIGURE 1. Little Piked Whale, *Balænoptera acuto-rostrata* Lacépède. Restoration, based on the Quoddy Head, Maine, specimen.

FIGURE 2. Pollack Whale, *Balænoptera borealis* Lesson. After Collett.

FIGURE 3. Gray Whale, *Rhachianectes glaucus* Cope. After Scammon.

PLATE 50.

FIGURE 1. Humpback, *Megaptera nodosa* (Bonnaterre). Restoration based on Sars's figures amended from Newfoundland specimens.

FIGURE 2. North Atlantic Right Whale, *Balæna glacialis* Bonnaterre. Restoration based on photographs of Massachusetts and Long Island specimens.

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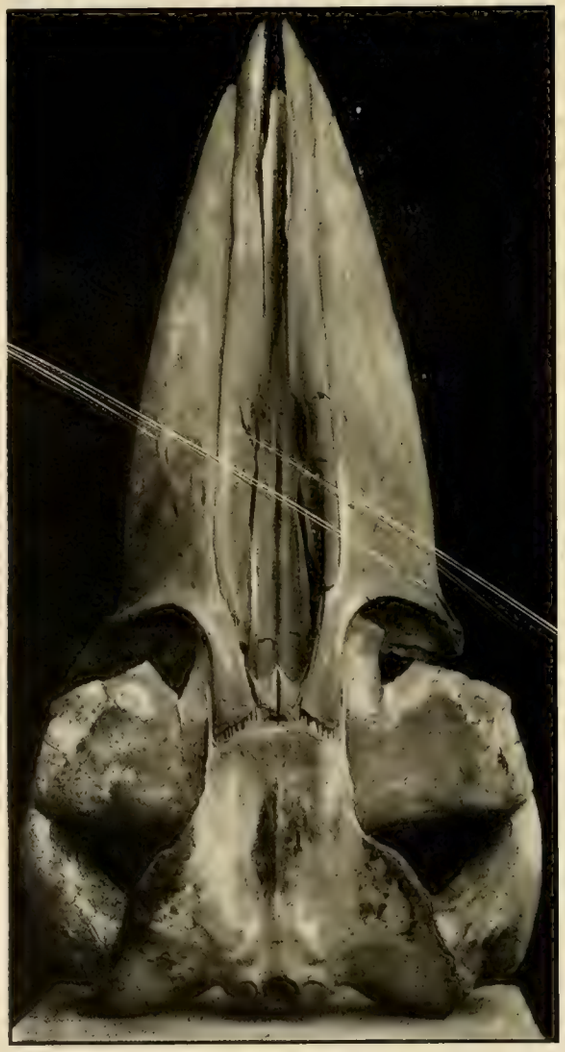


FIG. 1.

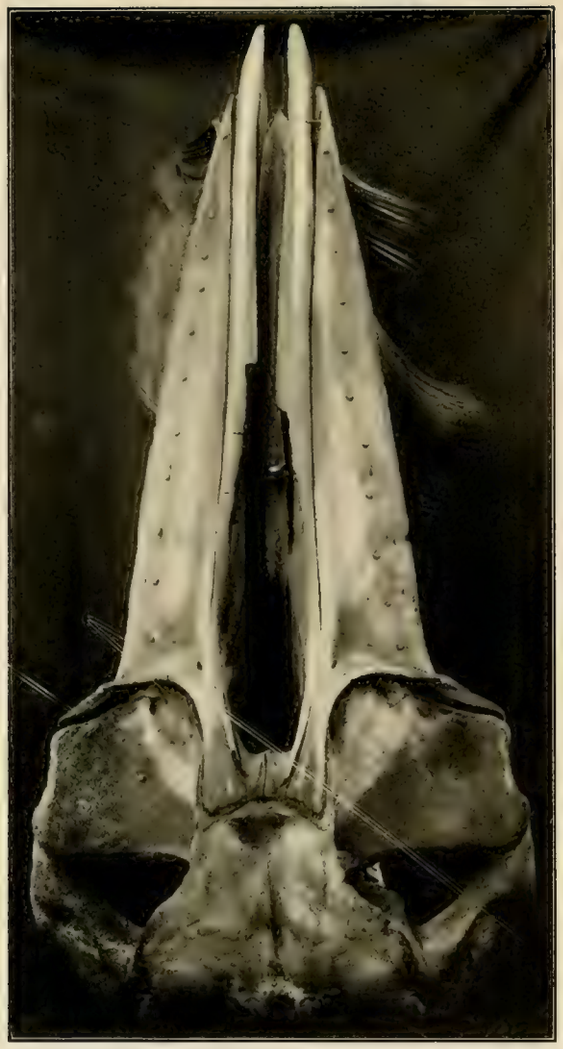


FIG. 2.

FIG. 3.

CRANIUM OF *BALÆNOPTERA PHYSALUS* (L.). DORSAL VIEW.

Fig. 1.—Type of *B. tectirostris* (Cope). Fig. 2.—Cape Cod, Mass., No. 16045 U. S. N. M. Fig. 3.—Cape Cod, Mass., No. 16039 U. S. N. M.

FIG. 1.

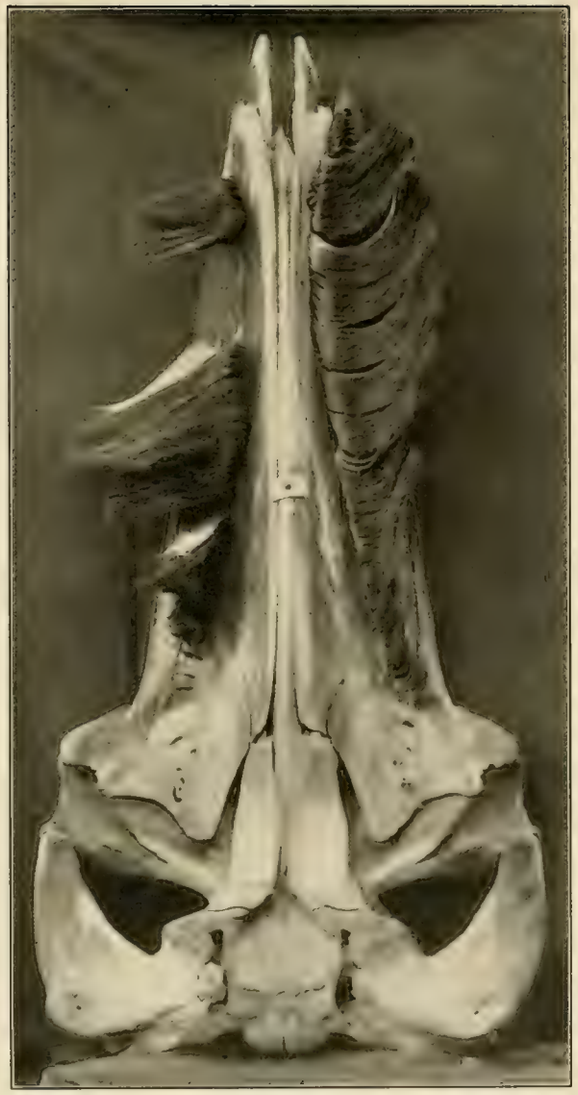


FIG. 2.

FIG. 3.

CRANIUM OF *BALÆNOPTERA PHYSALUS* (L.). VENTRAL VIEW

Fig. 1.—Type of *B. tectirostris* (Cope). Fig. 2.—Cape Cod, Mass., No. 10045 U. S. N. M. Fig. 3.—Cape Cod, Mass., No. 10030 U. S. N. M.

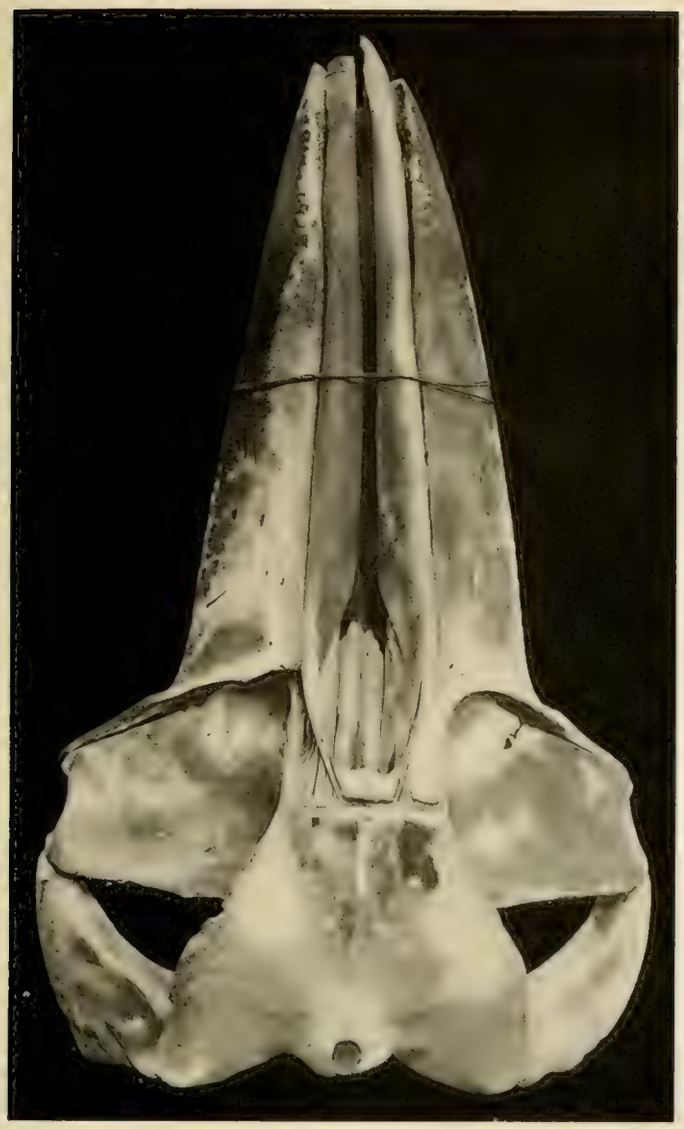


FIG. 1.

FIG. 2.

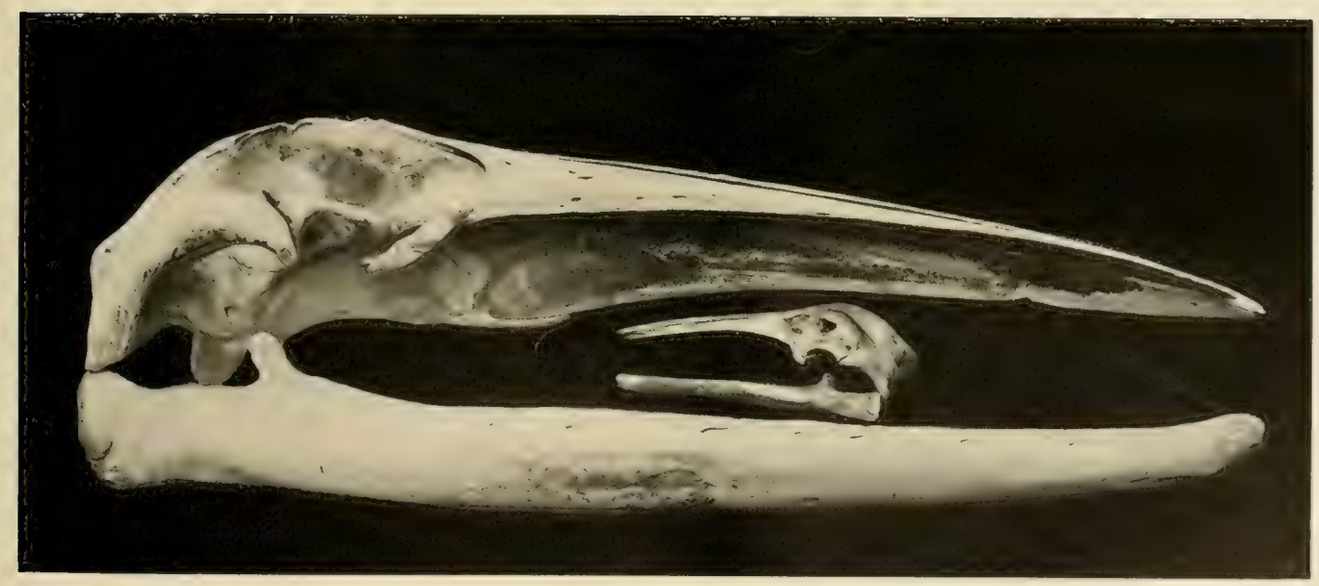


FIG. 3.

CRANIUM OF *BALÆNOPTERA PHYSALUS* (L.).

Figs. 1–3.—Cape Cod, Mass., Ward's Natural Science Establishment, Rochester, N. Y.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

BALÆNOPTERA PHYSALUS (L.).

Fig. 1.—Type of *B. tectirostris* (Cope). Fig. 2.—Cape Cod, Mass., No. 16045 U. S. N. M. Fig. 3.—Cape Cod, Mass., No. 16039 U. S. N. M.
Fig. 4.—Type of *B. tectirostris* (Cope); first rib, first lumbar vertebra, first dorsal vertebra, axis.

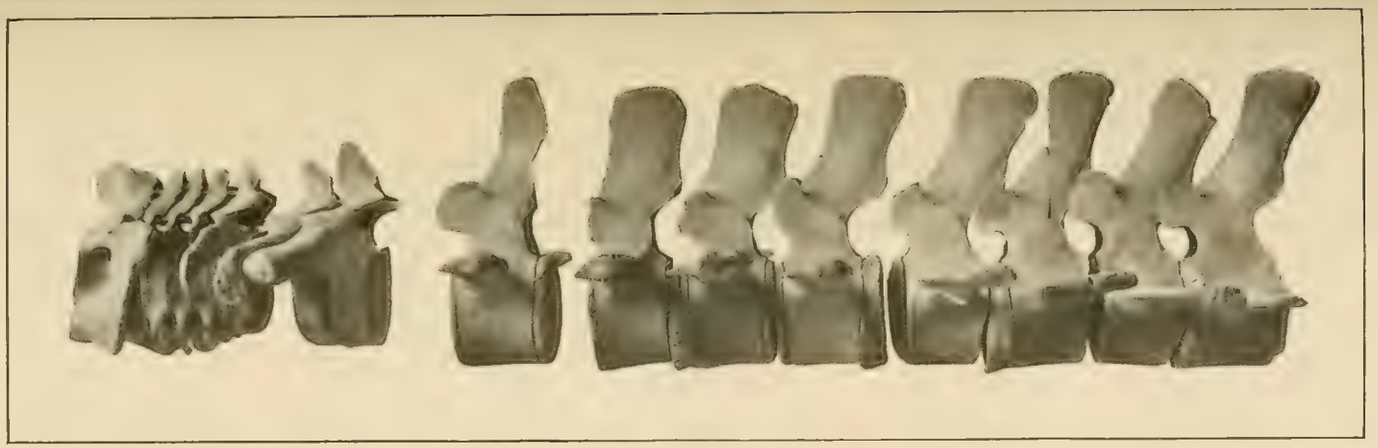


FIG. 1.

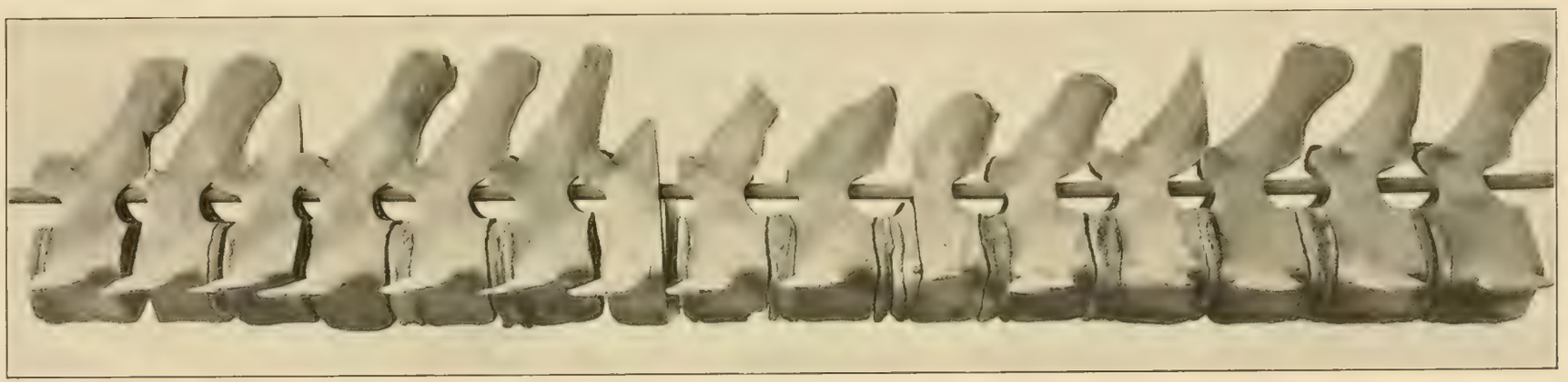


FIG. 2.

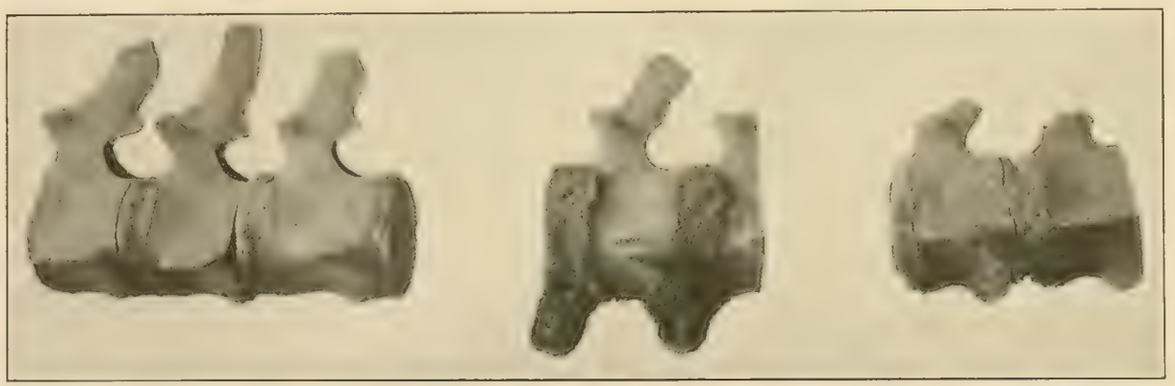


FIG. 3.

FIG. 4.

BALÆNOPTERA PHYSALUS (L.). [TYPE OF *B. TECTIROSTRIS* (COPE).]

Fig. 1.—Cervical and dorsal vertebræ. Fig. 2.—Lumbar vertebræ. Figs. 3 and 4.—Caudal vertebræ.

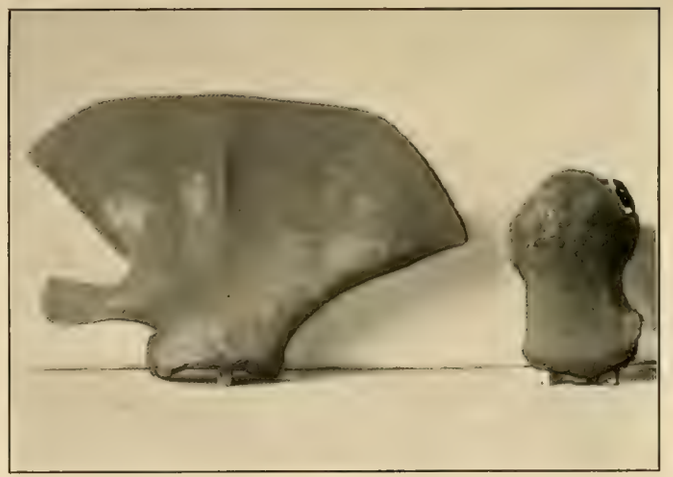


FIG. 2.

FIG. 3.

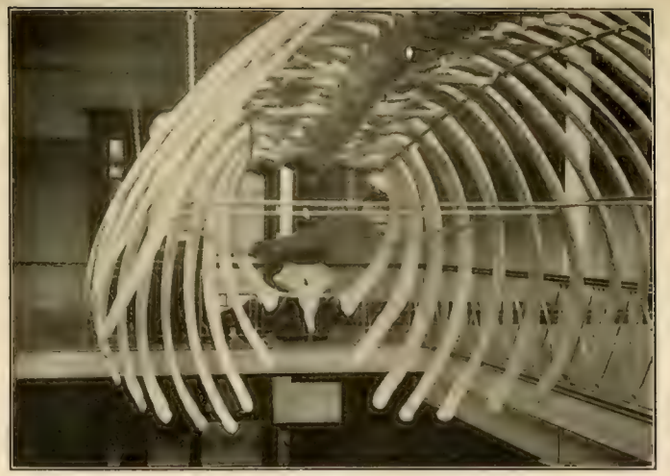


FIG. 4.

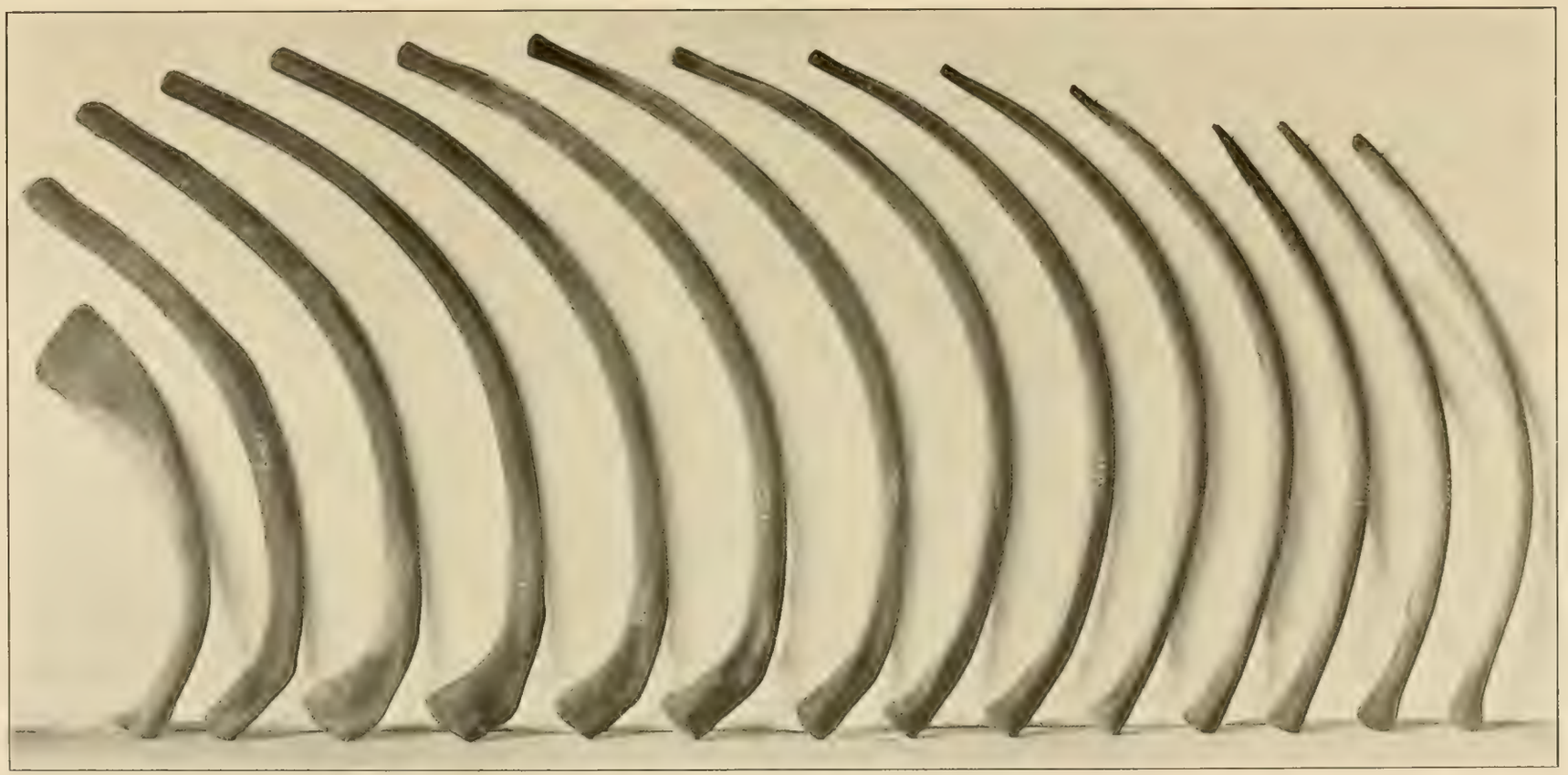


FIG. 1.

BALÆNOPTERA PHYSALUS (L.) AND *B. VELIFERA* COPE (?)

Fig. 1.—Type of *B. tectirostris* (Cope); ribs. Fig. 2.—*Ditto;* left scapula and humerus. Fig. 3.—*Ditto;* first rib. Fig. 4.—Skeleton of *B. velifera* (?), California.

FIG. 7.

FIG. 4.

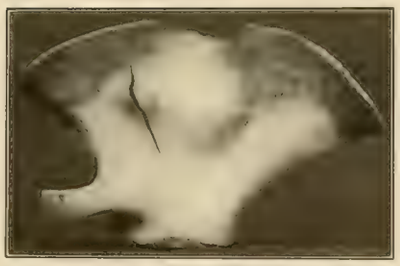


FIG. 1.

FIG. 3.

FIG. 2.

FIG. 10.

FIG. 8.

FIG. 9.

FIG. 5.

FIG. 6.

BALÆNOPTERA PHYSALUS (L.), *B. MUSCULUS* (L.), AND *B. VELIFERA* COPE (?).

Fig. 1.—*B. physalus*, Cape Cod, Mass., No. 16039 U. S. N. M. Figs. 2 and 4.—*Ditto*, No. 16045 U. S. N. M. Fig. 3.—*B. velifera* (?), California. Figs. 5, 9, 10.—*B. musculus*, Newfoundland. Figs. 6–8.—*Ditto*, Ocean City, N. J.

FIG. 1.

FIG. 2.

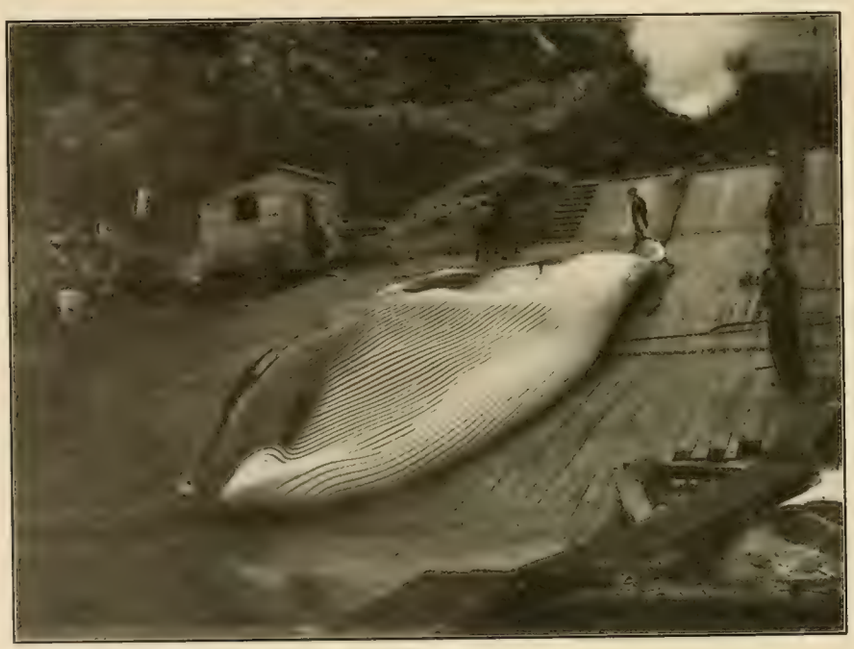


FIG. 3.

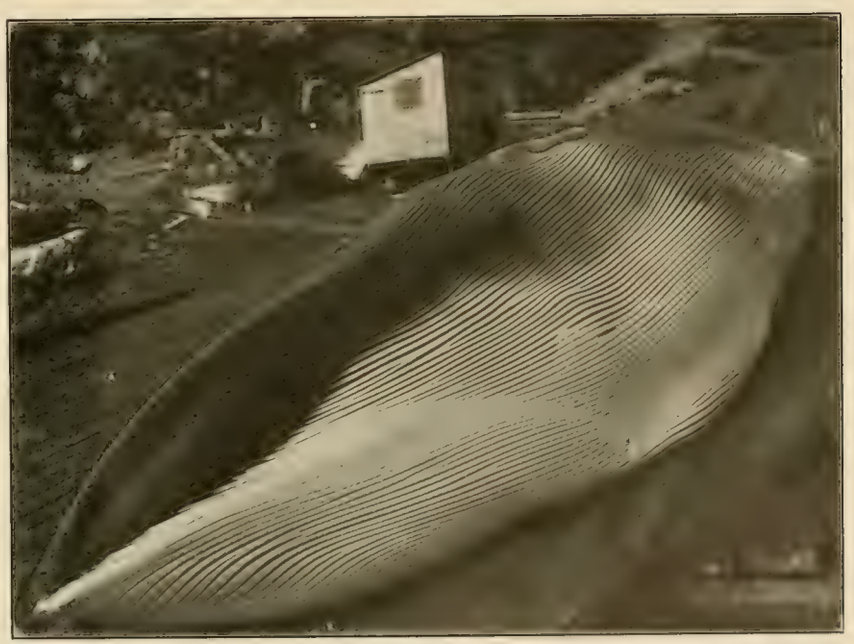


FIG. 4.

BALÆNOPTERA PHYSALUS (L.). SNOOK'S ARM, NEWFOUNDLAND.

Fig. 1.—No. 7, ♀. Fig. 2.—No. 18, ♀. Fig. 3.—No. 9, ♂. Fig. 4.—No. 13, ♂.

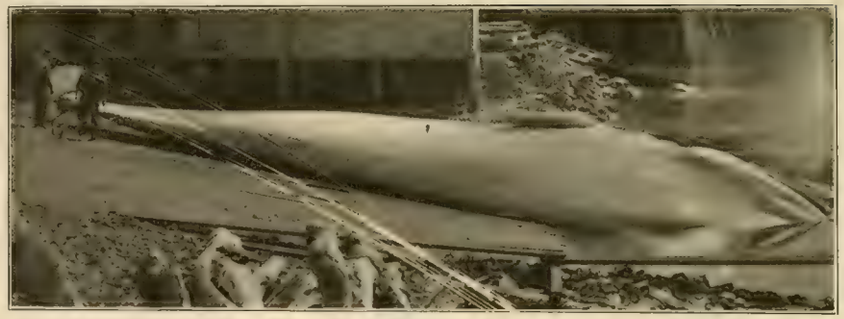


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 5.

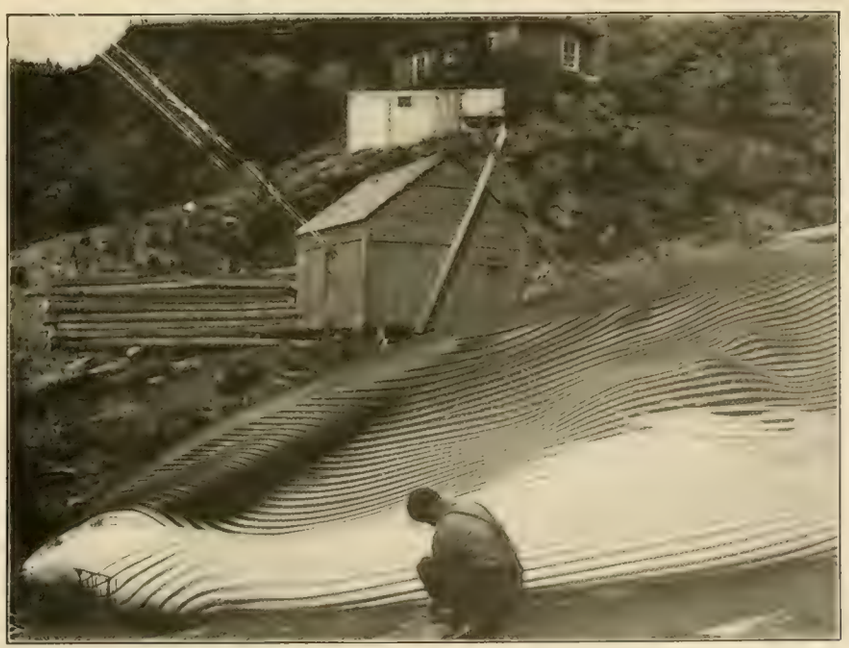


FIG. 4.

BALÆNOPTERA PHYSALUS (L.). SNOOK'S ARM, NEWFOUNDLAND.

Fig. 1.—No. 7, ♀. Fig. 2.—No. 4, ♀. Fig. 3.—No. 20, ♀. Fig. 4.—No. 2, ♀. Fig. 5.—No. 17, ♂.

FIG. 1.

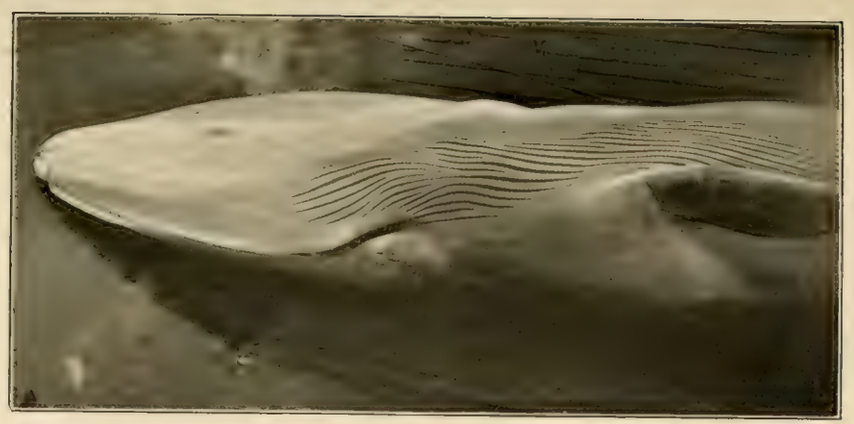


FIG. 3.

FIG. 4. *a* *b* *c* *d*

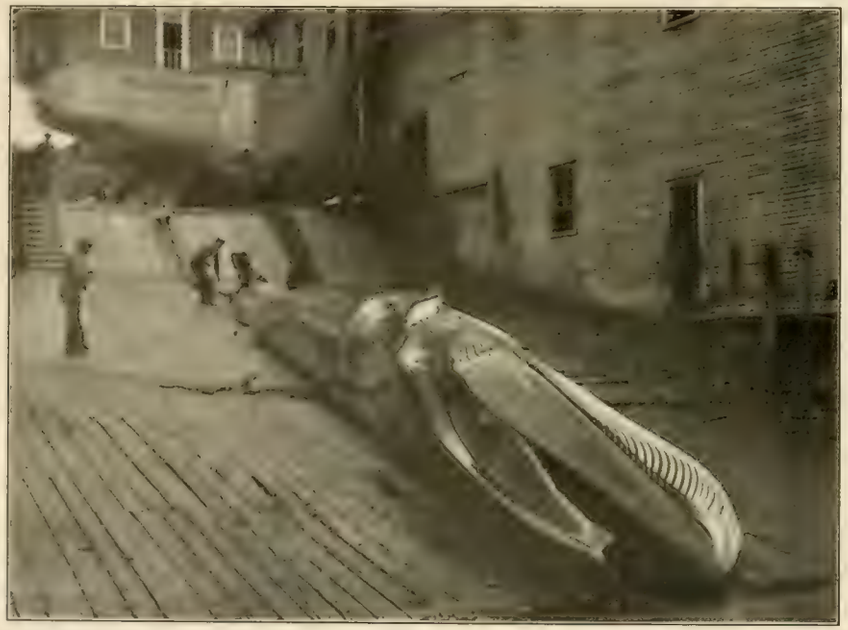


FIG. 2.

FIG. 5.

BALÆNOPTERA PHYSALUS (L.) SNOOK'S ARM, NEWFOUNDLAND.

Fig. 1.—No. 20, ♀. Figs. 2 and 5.—No. 9, ♂. Fig. 3.—No. 17, ♂. Fig. 4.—No. 18, ♀.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

BALÆNOPTERA PHYSALUS (L.). SNOOK'S ARM, NEWFOUNDLAND.

Fig. 1.—No. 12, ♂. Fig. 2.—No. 13, ♂. Figs. 3, 5, 6.—No. 18, ♀. Fig. 4.—No. 7, ♀.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

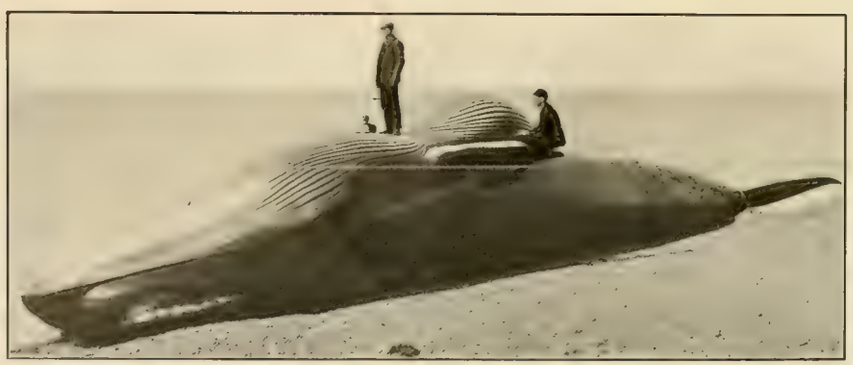


FIG. 1.

FIG. 2.

BALÆNOPTERA PHYSALUS (L.)

Figs. 1 and 2.—Provincetown, Mass. Figs. 3-5.—*Ditto*; another specimen. Fig. 6.—Nantucket, Mass. Fig 7.—Snook's Arm, Newfoundland, No. 26, ♂. Fig. 8.—*Ditto*, No. 25, ♂.

FIG. 3.

FIG. 4.

FIG. 1.

FIG. 2.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND

Fig. 1.—No. 2, ♀. Fig. 2.—No. 3, ♀. Figs. 3 and 4.—No. 23, ♀.

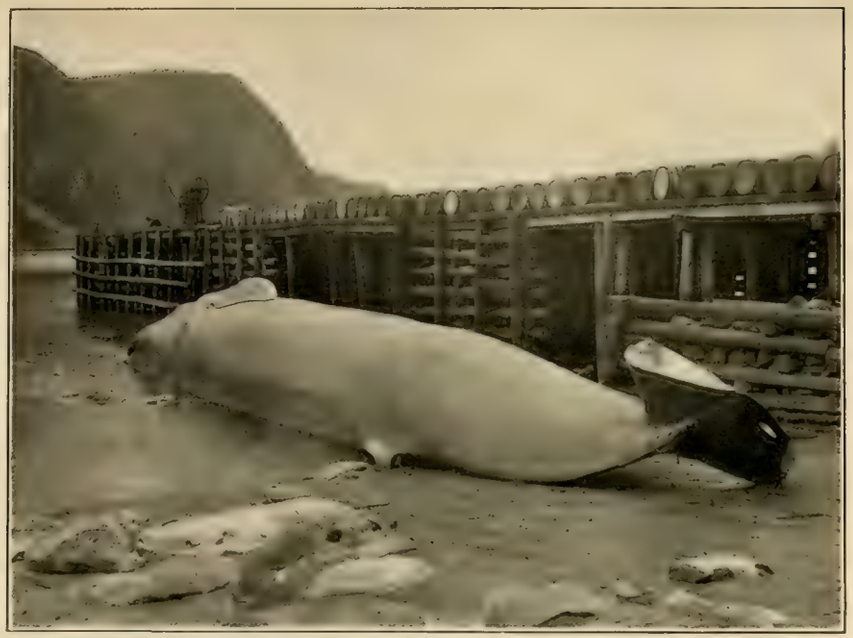


FIG. 1.

FIG. 2.

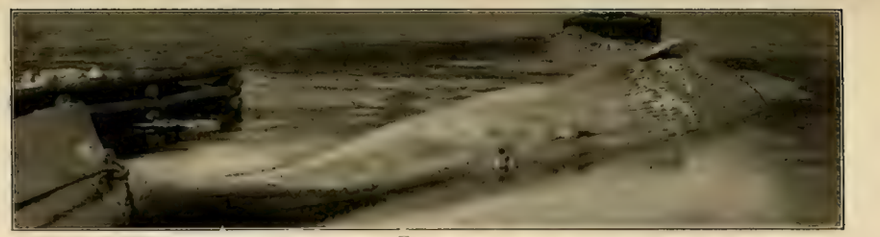


FIG. 3.

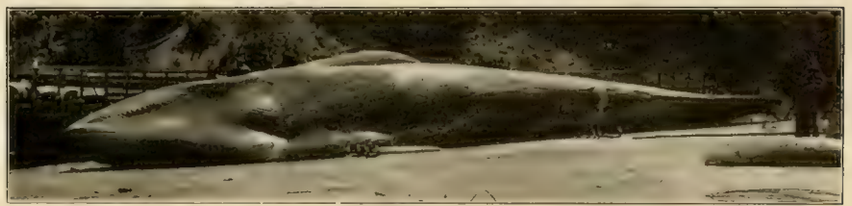


FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND

Fig. 1.—No. 9, ♀. Figs. 2 and 6.—No. 21, ♀. Fig. 3.—No. 10, ♂. Fig. 4.—No. 2, ♂. Fig. 5.—No. 8, ♀. Fig. 7.—No. 6, ♂.

FIG. 1.

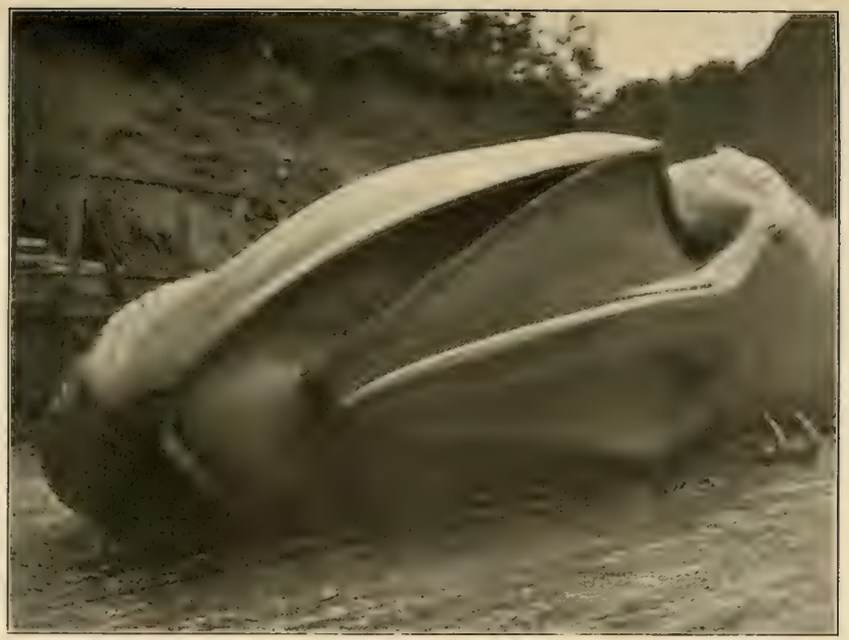


FIG. 2.

FIG. 3.

FIG. 4.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND.

Fig. 1.—No. 3, ♀. Fig. 2.—No. 6, ♂. Figs. 3 and 4.—No. 23, ♀.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND.

Figs. 1 and 2.—No. 23, ♀. Fig. 3.—No. 9, ♀. Fig. 4.—No. 14 ♀.

FIG. 1.

FIG. 3.

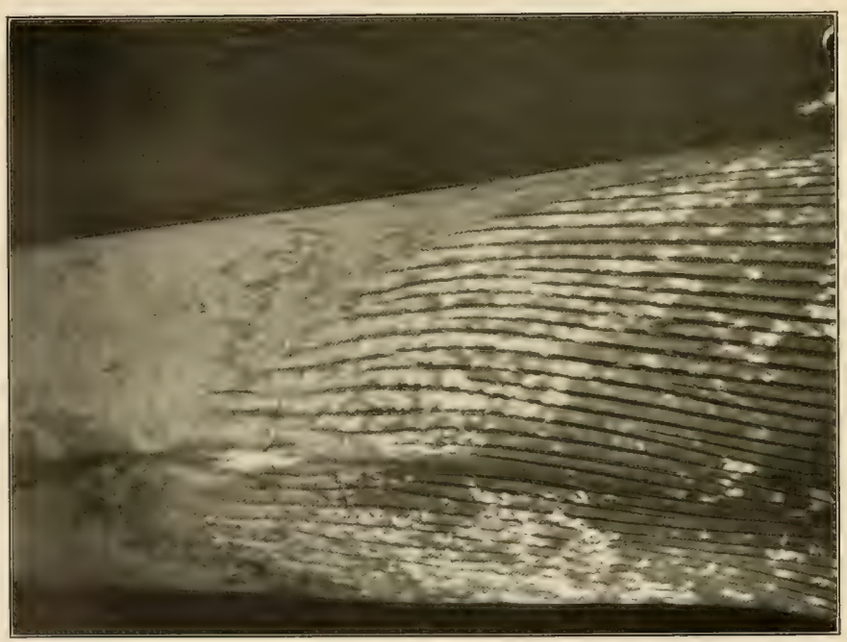


FIG. 2.

FIG. 4.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND.

Figs. 1 and 3.—No. 26, ♀. Figs. 2 and 4.—No. 20, ♀.

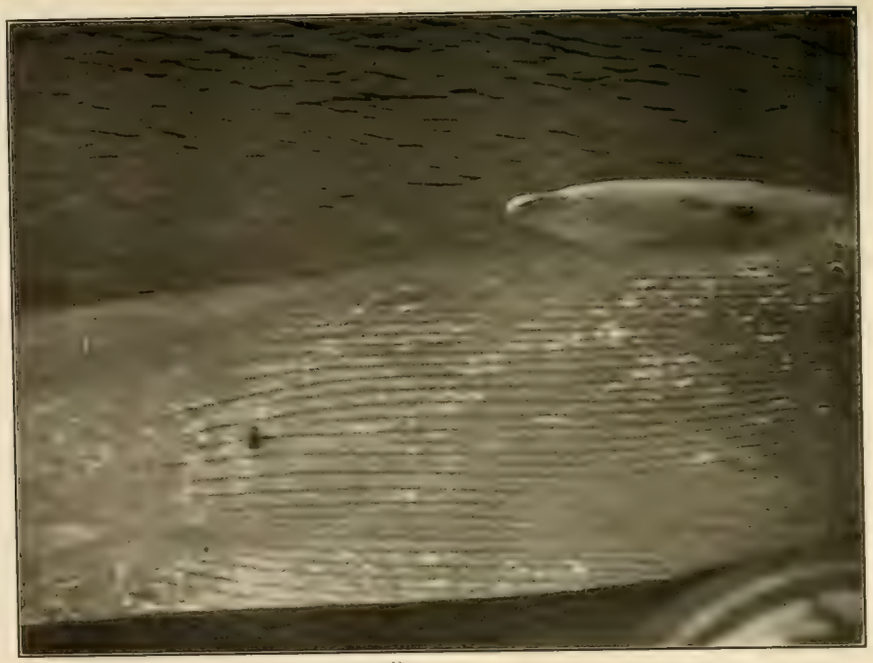


FIG. 1.

FIG. 2.

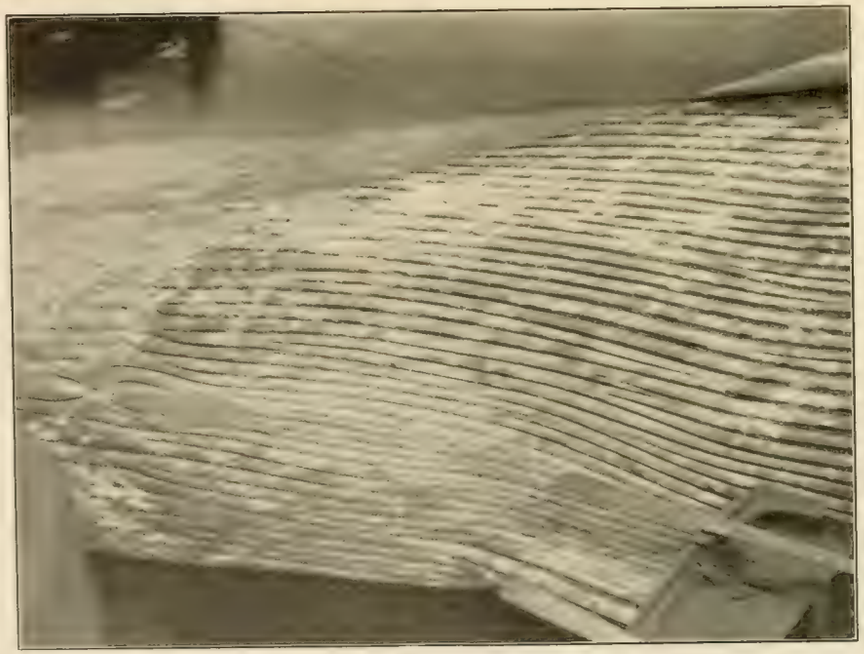


FIG. 3.

FIG. 4.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND

Fig. 1.—No. 5, ♂. Fig. 2.—No. 21, ♀. Figs. 3 and 4.—No. 9, ♀.

FIG. 1.

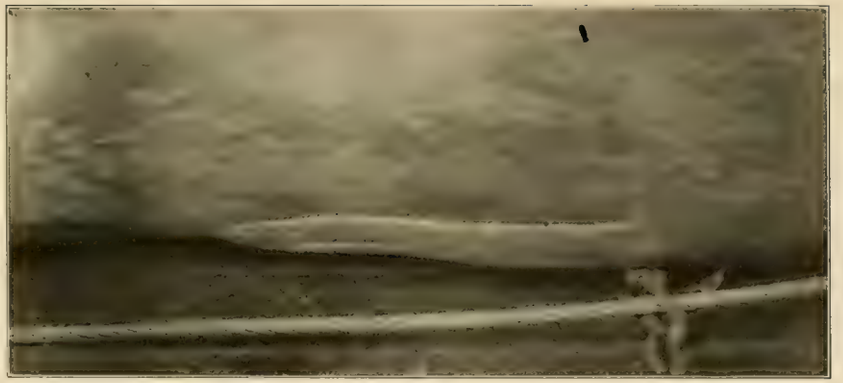


FIG. 3.

FIG. 2.

FIG. 4.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND.

Fig. 1.—No. 7, ♂. Fig. 2.—No. 8, ♀. Fig. 3.—No. 23, ♀. Fig. 4.—Piece of skin.

FIG. 1.

FIG. 2.

FIG. 3.

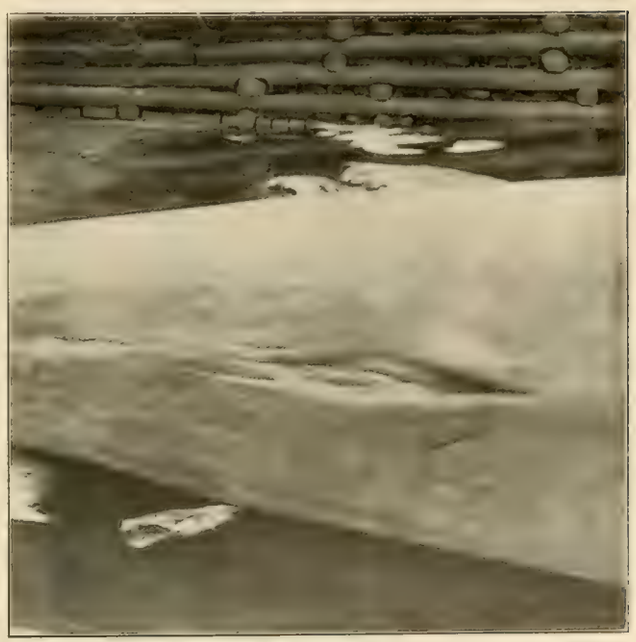


FIG. 4.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND.

Fig. 1.—No. 8, ♀. Fig. 2.—No. 21, ♀. Fig. 3.—No. 11, ♂. Fig. 4.—No. 15, ♂.

FIG. 1.

FIG. 2.

FIG. 4.

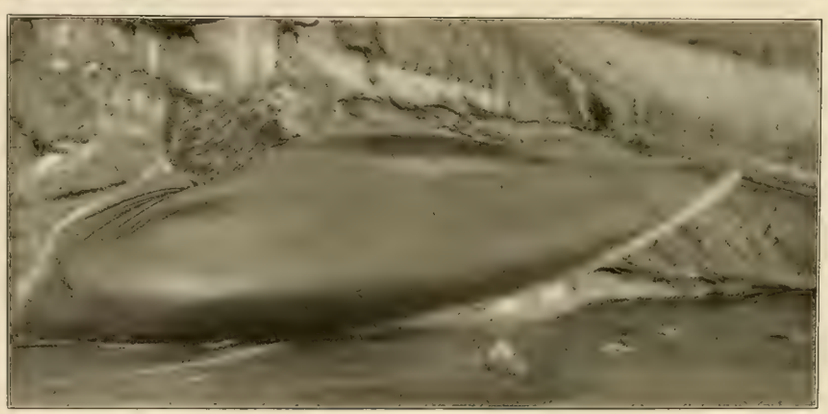


FIG. 5.

FIG. 3.

BALÆNOPTERA MUSCULUS (L.). BALENA STATION, NEWFOUNDLAND.

Figs. 1 and 2.—No. 8, ♀. Fig. 3.—No. 21, ♀. Fig. 4.—No. 7, ♂. Fig. 5.—No. 4, ♀.

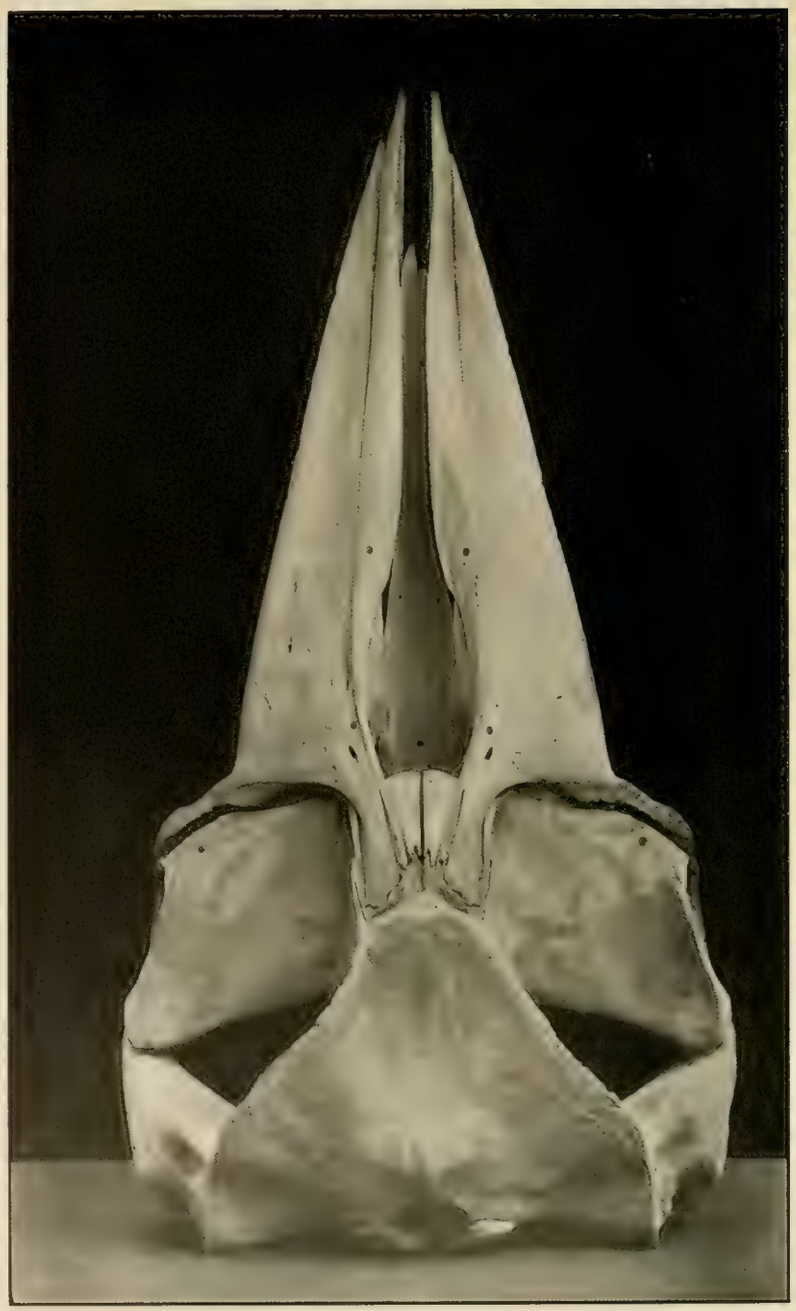


FIG. 1.

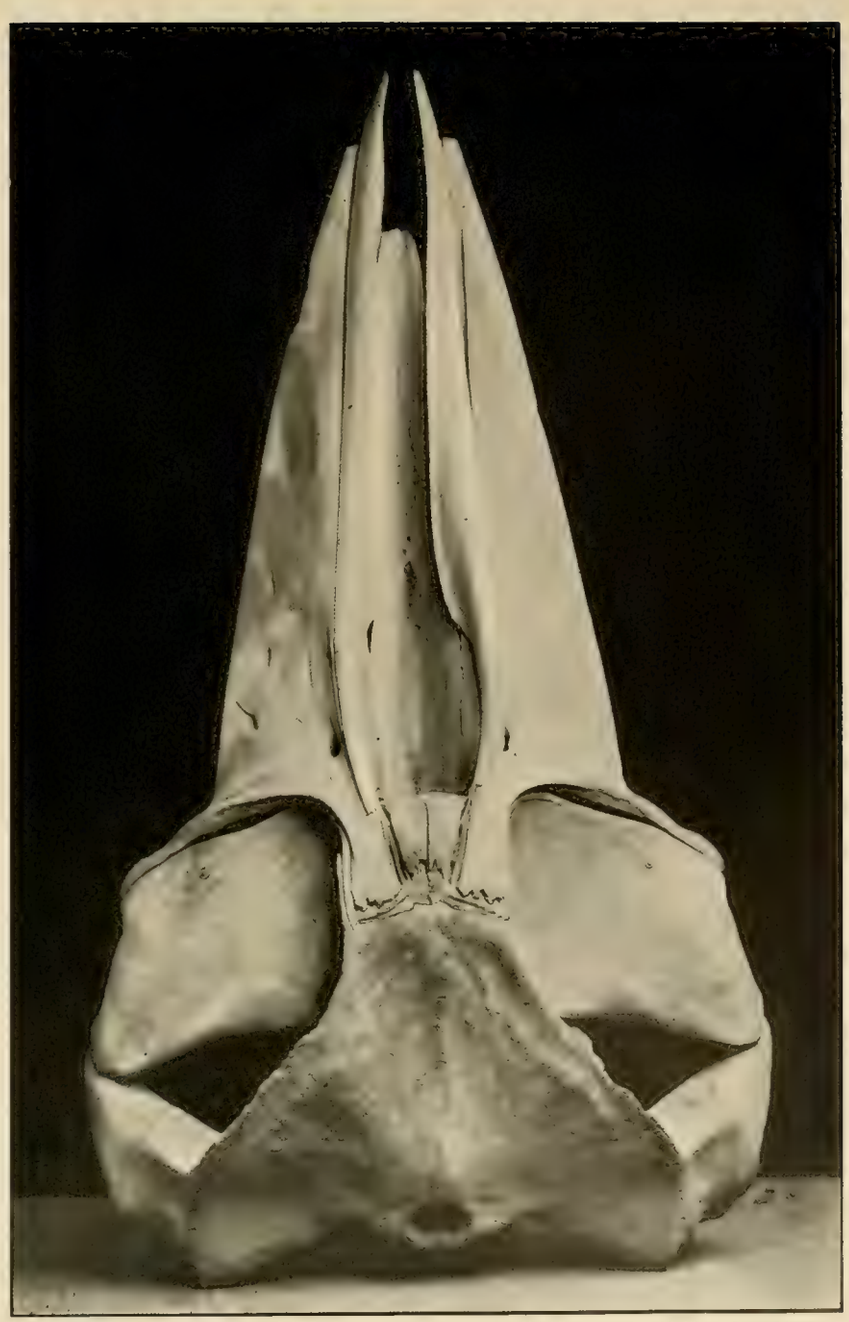


FIG. 2.

CRANIUM OF *BALÆNOPTERA ACUTO-ROSTRATA* LACÉPÈDE. DORSAL VIEW.

Fig. 1.—Harwichport, Mass., No. 20931 U. S. N. M. Fig. 2.—Coast of Norway, No. 13877 U. S. N. M.

FIG. 1.

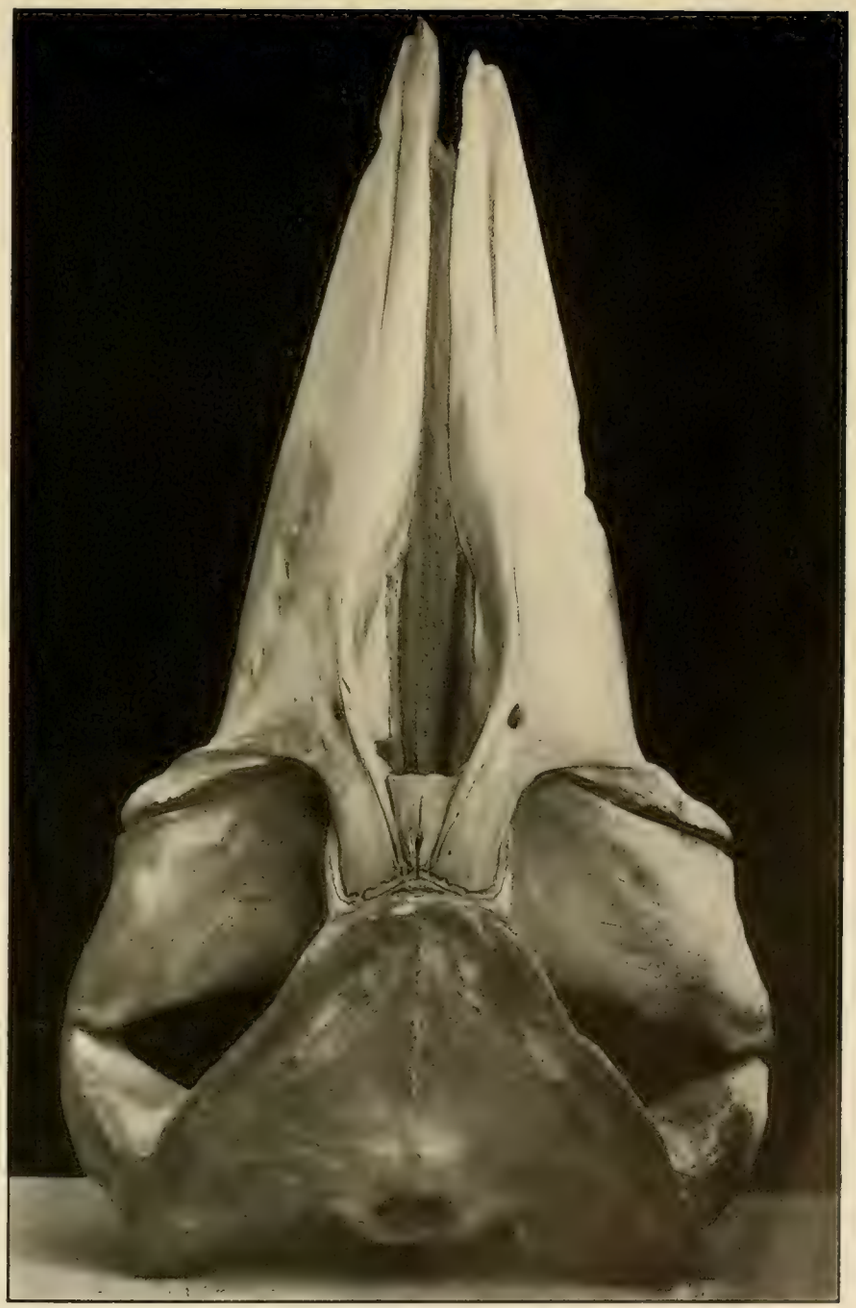


FIG. 2.

CRANIUM OF *BALÆNOPTERA DAVIDSONI* SCAMMON. DORSAL VIEW.

Fig. 1.—Type of *B. davidsoni*, No. 12177, U. S. N. M. Fig. 2.—Pribilof Ids., Alaska. No. 61715 U. S. N. M.

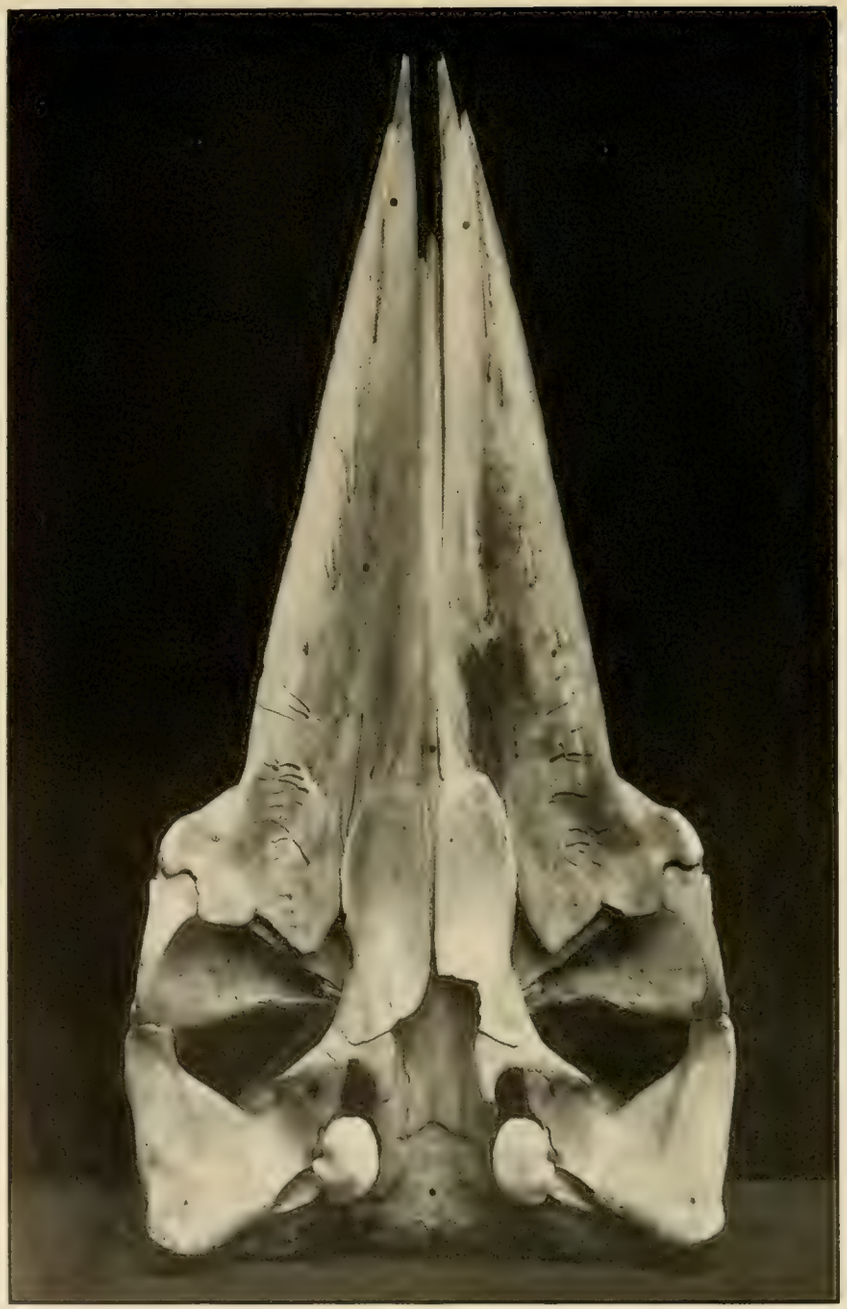


FIG. 1.

FIG. 2.

CRANIUM OF *BALÆNOPTERA ACUTO-ROSTRATA* LACÉPÈDE. VENTRAL VIEW.

Fig. 1.—Harwichport, Mass., No. 20931 U. S. N. M. Fig. 2.—Coast of Norway, No. 13877 U. S. N. M.

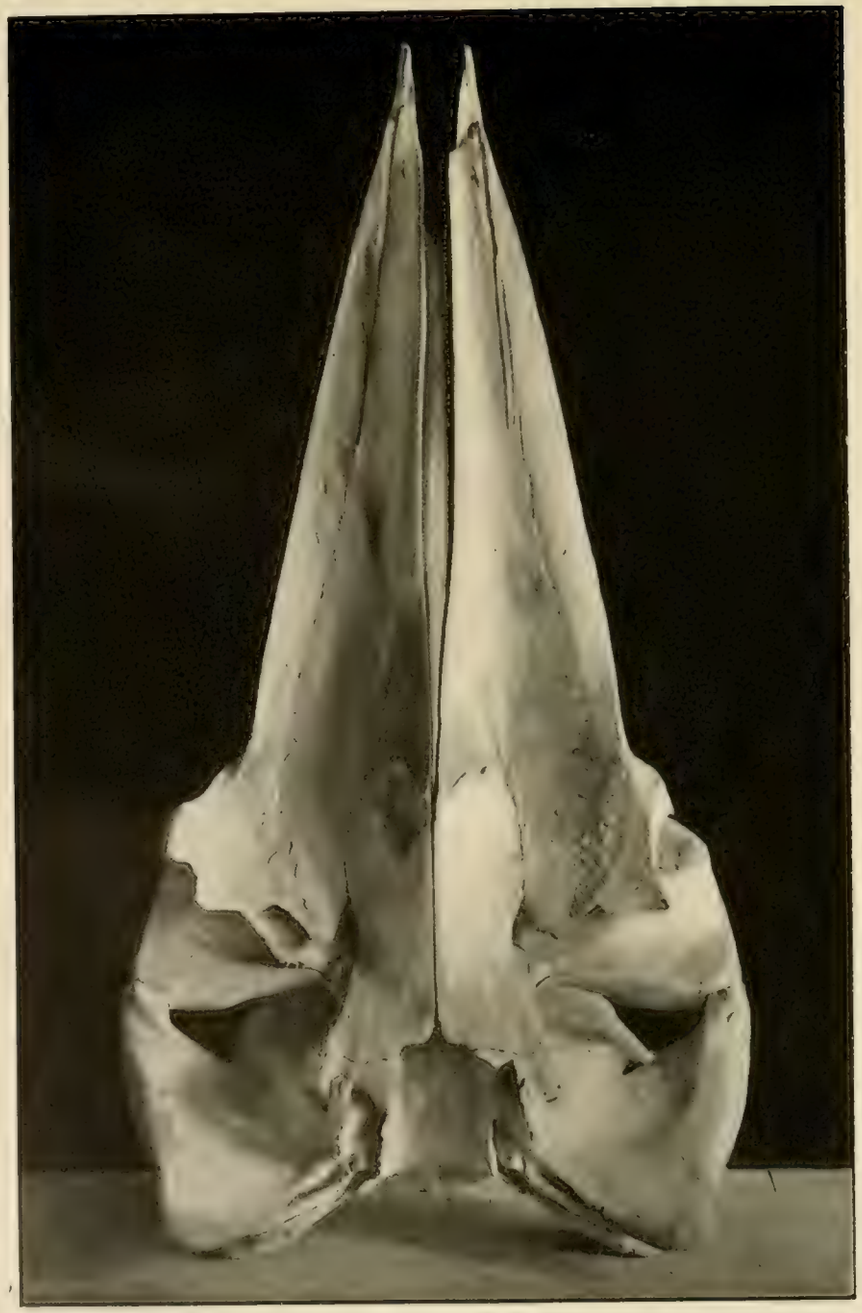


FIG. 1.

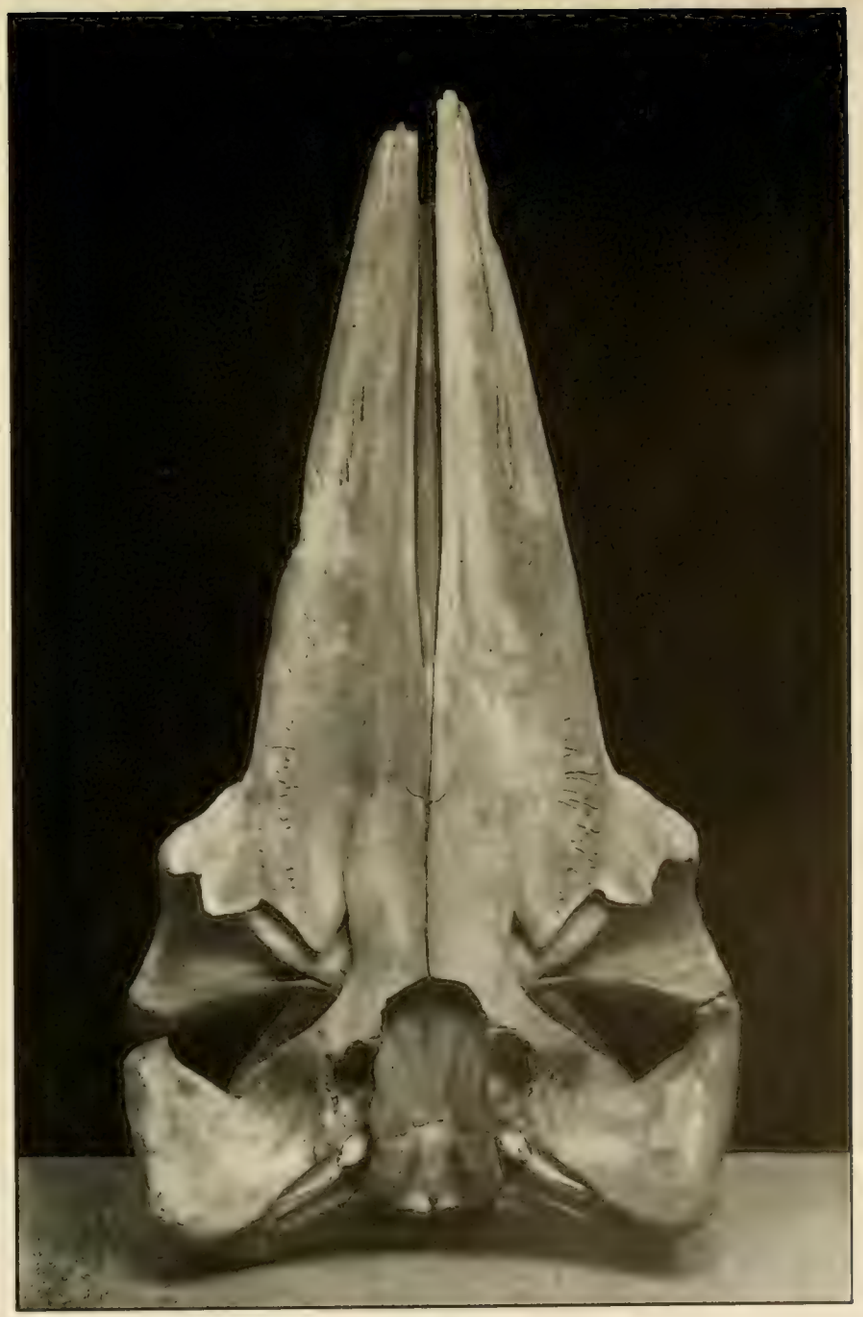


FIG. 2.

CRANIUM OF *BALÆNOPTERA DAVIDSONI* SCAMMON. VENTRAL VIEW.

Fig. 1.—Type of *B. davidsoni*, No. 12177 U. S. N. M. Fig. 2.—Pribilof Ids., Alaska, No. 61715 U. S. N. M.

FIG. 1.

FIG. 2.

FIG. 3.

CRANIUM OF *BALÆNOPTERA DAVIDSONI* AND *B. ACUTO-ROSTRATA*. LATERAL VIEW.

Fig. 1.—Type of *B. davidsoni*, No. 12177 U. S. N. M. Fig. 2.—*B. acuto-rostrata*, Harwichport, Mass., No. 20931 U. S. N. M. Fig. 3.—*Ditto*, Coast of Norway, No. 13877 U. S. N. M.

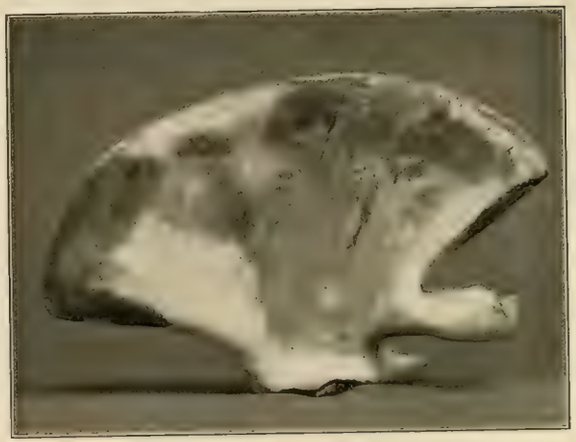


FIG. 3.

FIG. 4.

FIG. 5.

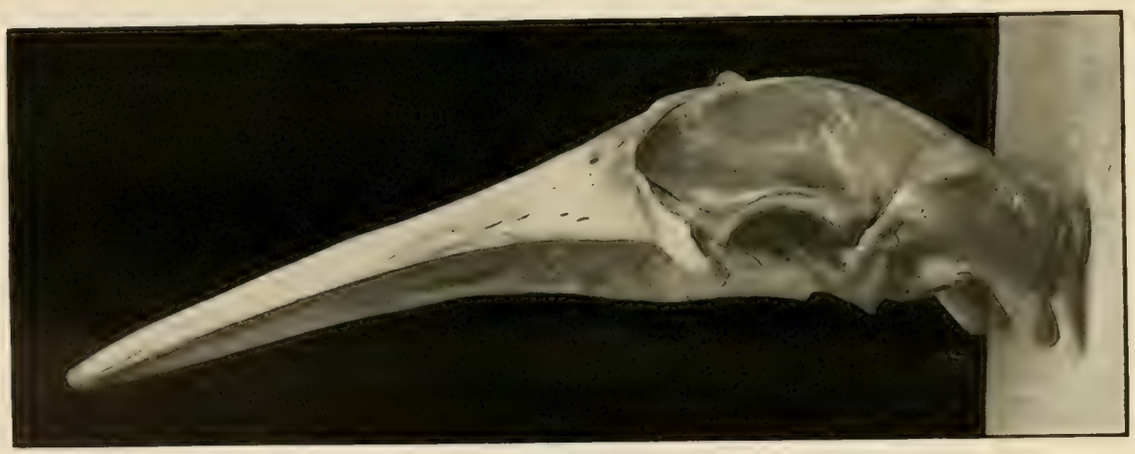


FIG. 1.

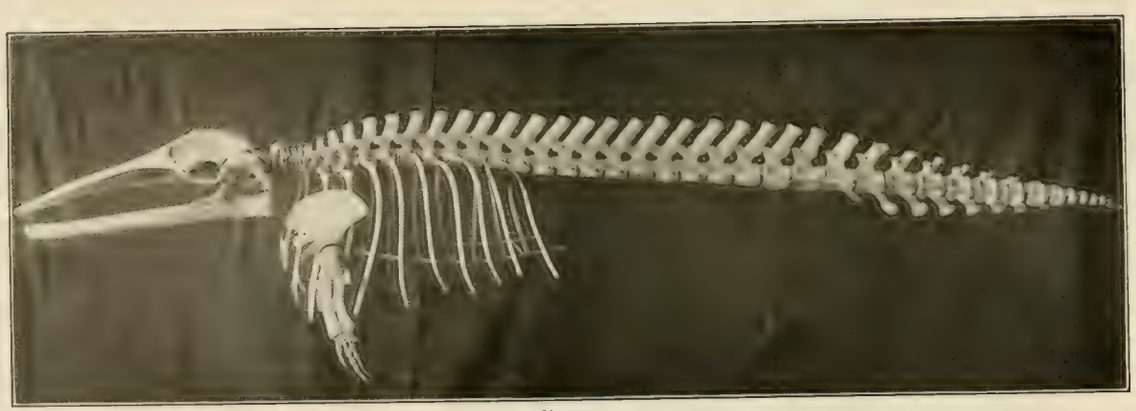


FIG. 2.

FIG. 6.

BALÆNOPTERA DAVIDSONI AND *B. ACUTO-ROSTRATA*

Fig. 1.—*B. davidsoni*, Pribilof Ids., Alaska, No. 61715 U. S. N. M. Figs. 2, 4, 6.—*B. acuto-rostrata*, Harwichport, Mass., No. 20931 U. S. N. M.
Figs. 3 and 5.—*Ditto*, Coast of Norway, No. 13877 U. S. N. M.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

BALÆNOPTERA DAVIDSONI, ACUTO-ROSTRATA, AND *VELIFERA* (?).

Figs. 1 and 2.—*B. davidsoni*, Valdes, Alaska. Figs. 3 and 4.—*B. acuto-rostrata*, Quoddy Head, Maine. Figs. 5 and 6.—*B. velifera* (?), California.

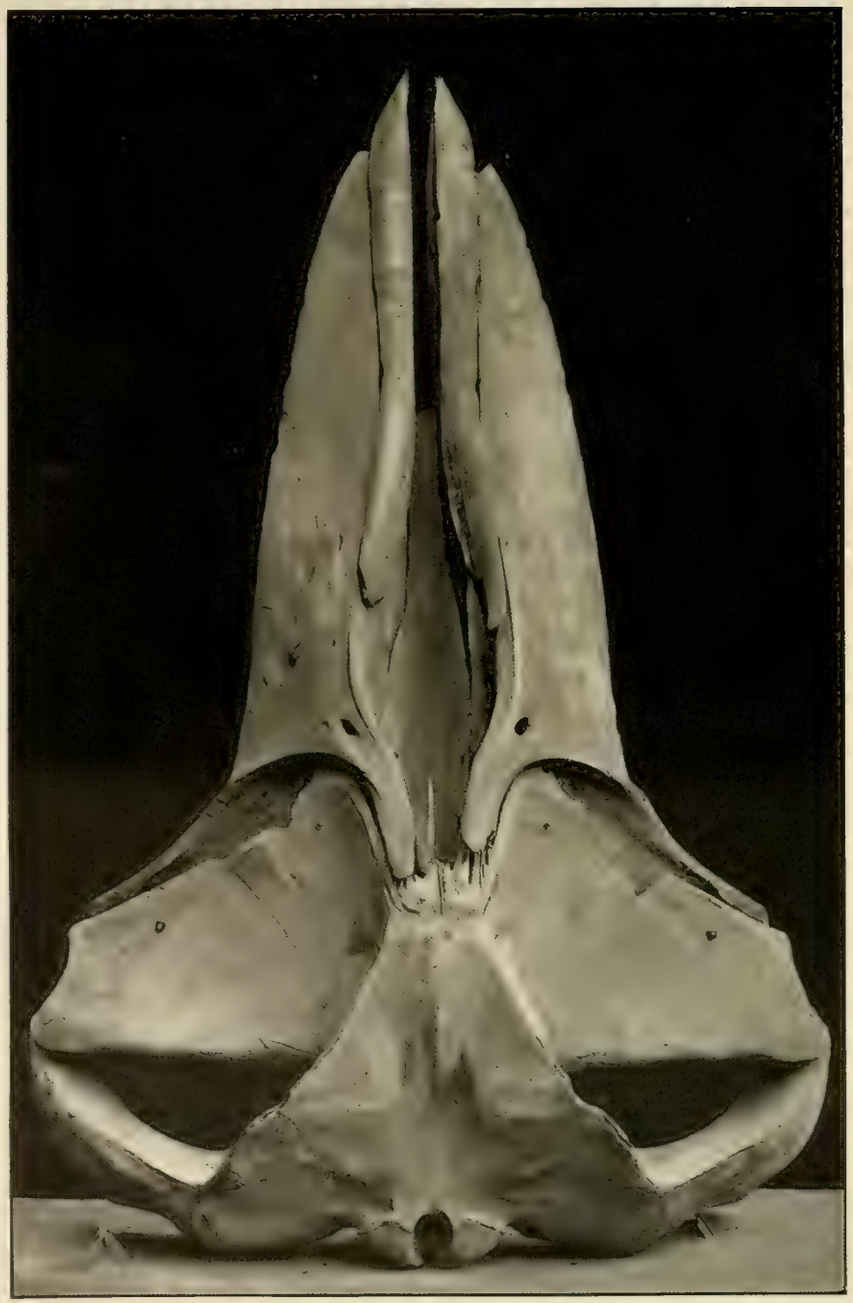


FIG. 1.

FIG. 2.

CRANIUM OF *MEGAPTERA NODOSA* (BONNATERRE). DORSAL VIEW.

Fig. 1.—Type of *M. bellicosa* Cope. Fig. 2.—Cape Cod, Mass., No. 21492 U. S. N. M.

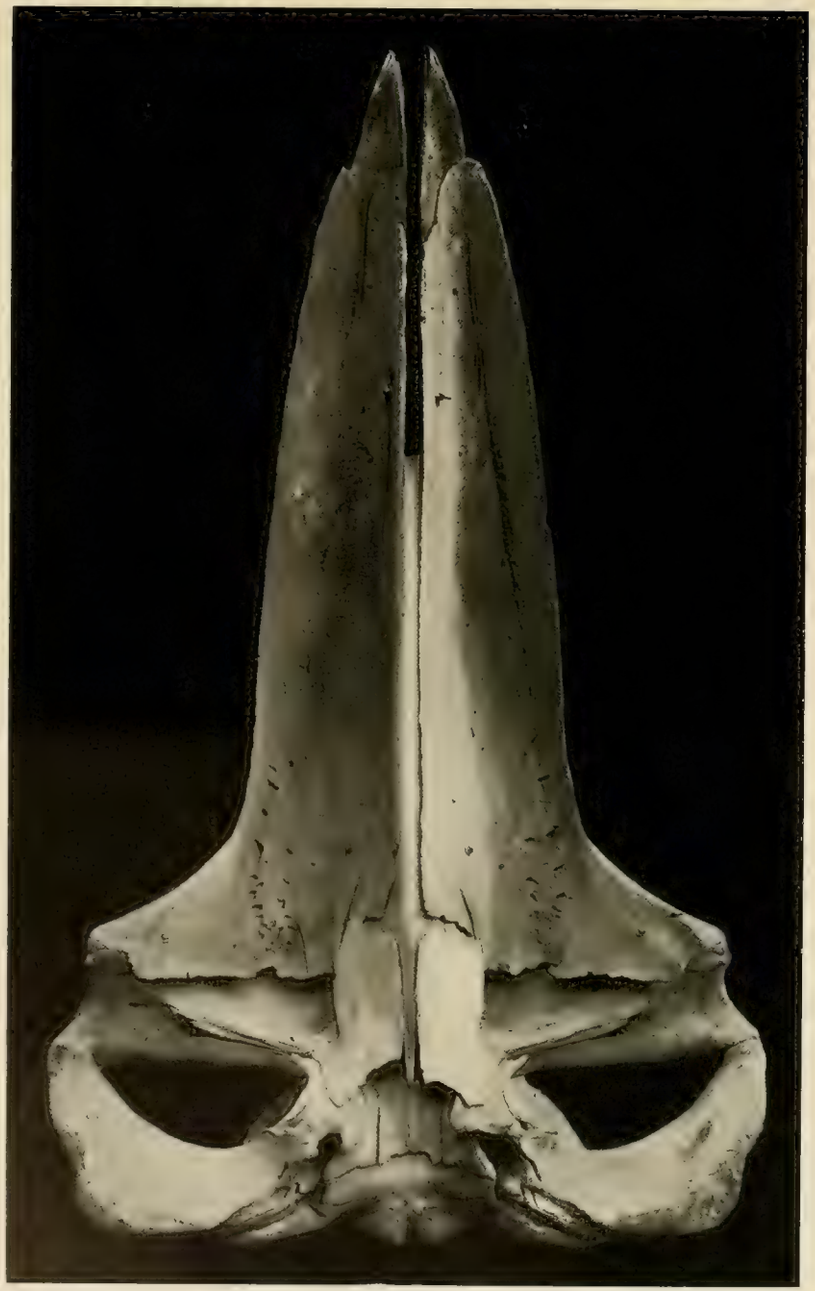


FIG. 1.

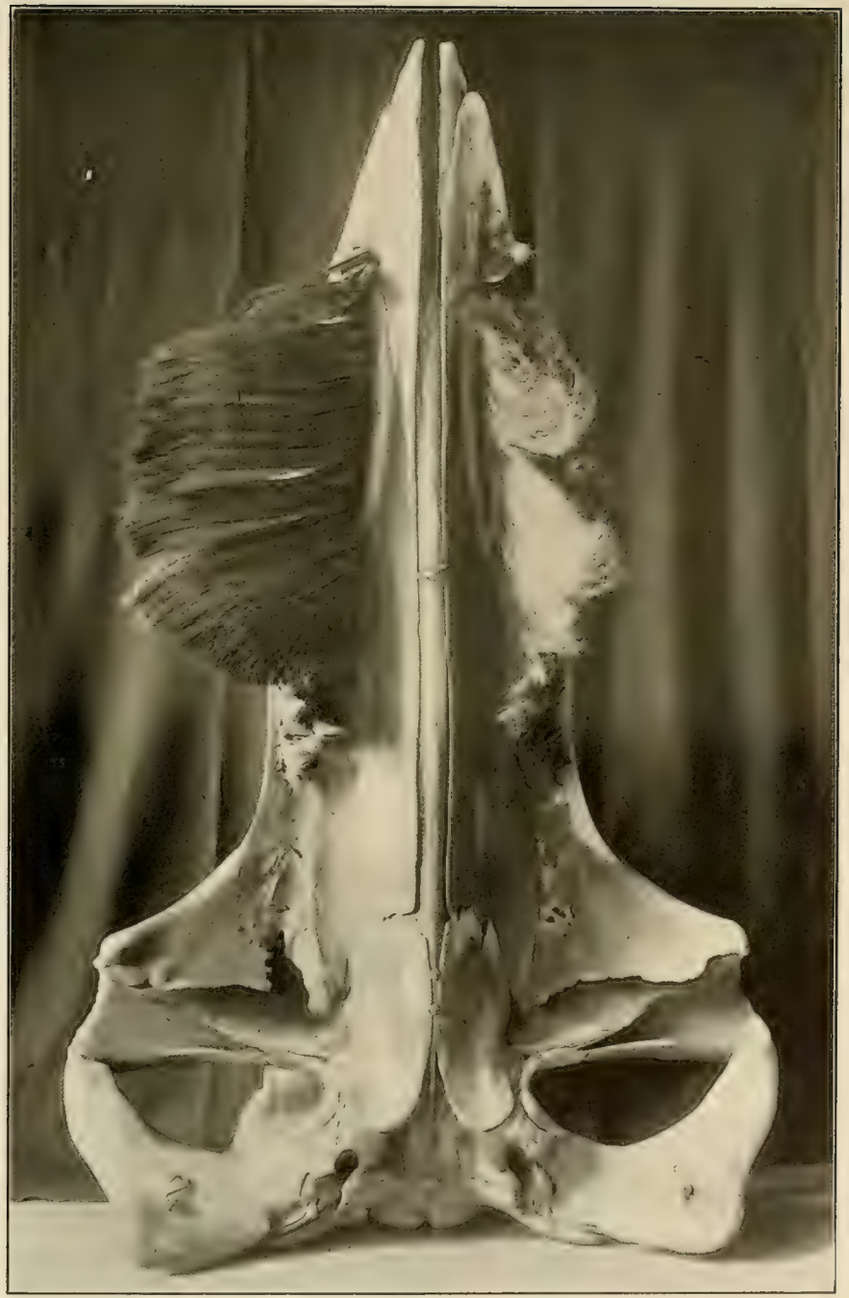


FIG. 2.

CRANIUM OF *MEGAPTERA NODOSA* (BONNATERRE). VENTRAL VIEW.

Fig. 1.—Type of *M. bellicosa* Cope. Fig. 2.—Cape Cod, Mass., No. 21492 U. S. N. M.

FIG. 1.

FIG. 2.

FIG. 3.

CRANIUM OF *MEGAPTERA NODOSA* (BONNATERRE). LATERAL VIEW.

Fig. 1.—Type of *M. bellicosa* Cope. Fig. 2.—Cape Cod, Mass., No. 21492 U. S. N. M.
Fig. 3.—Cape Cod, Mass. (Milwaukee Public Museum.)

FIG. 1.

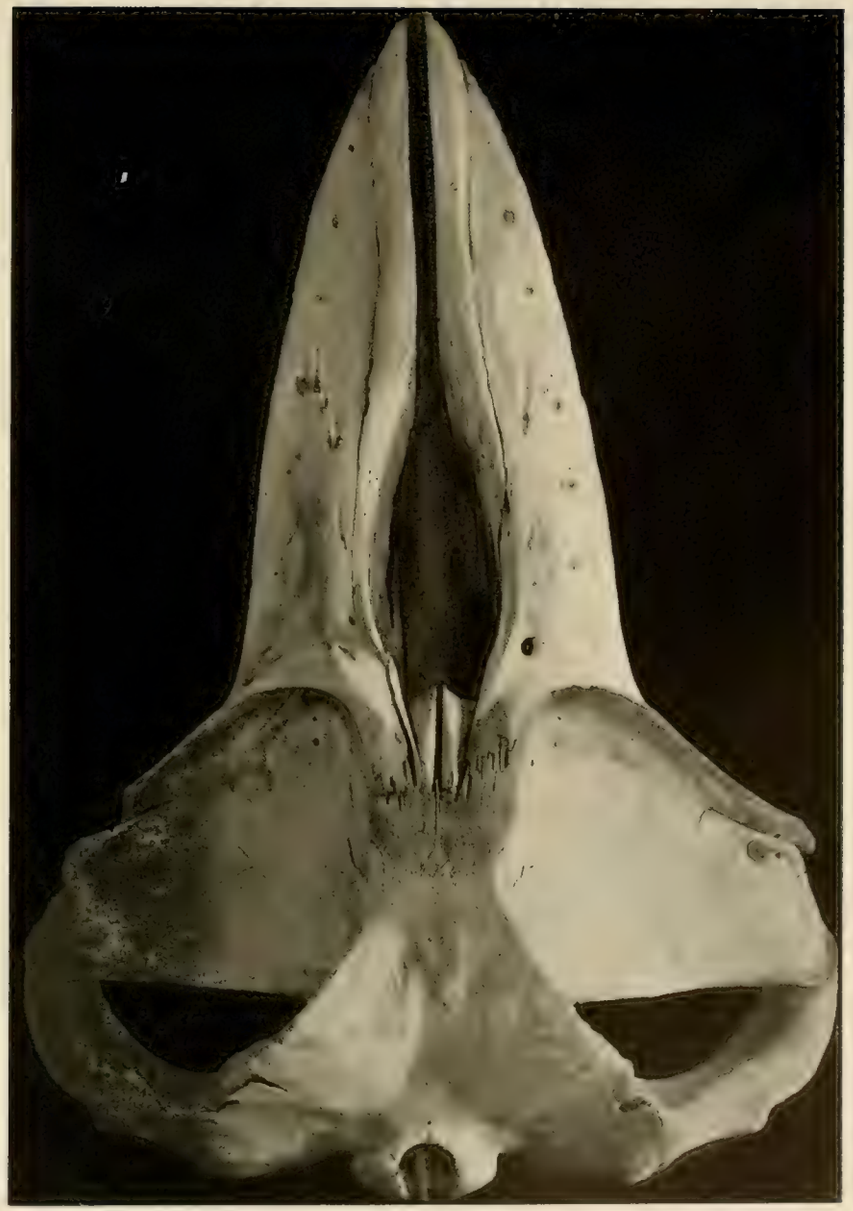


FIG. 2.

CRANIUM OF *MEGAPTERA NODOSA* (BONNATERRE). DORSAL VIEW.

Fig. 1.—Provincetown, Mass., Jr., No. 16252 U. S. N. M. Fig. 2.—Cape Cod, Mass. (Milwaukee Public Museum). (Figure distorted.)

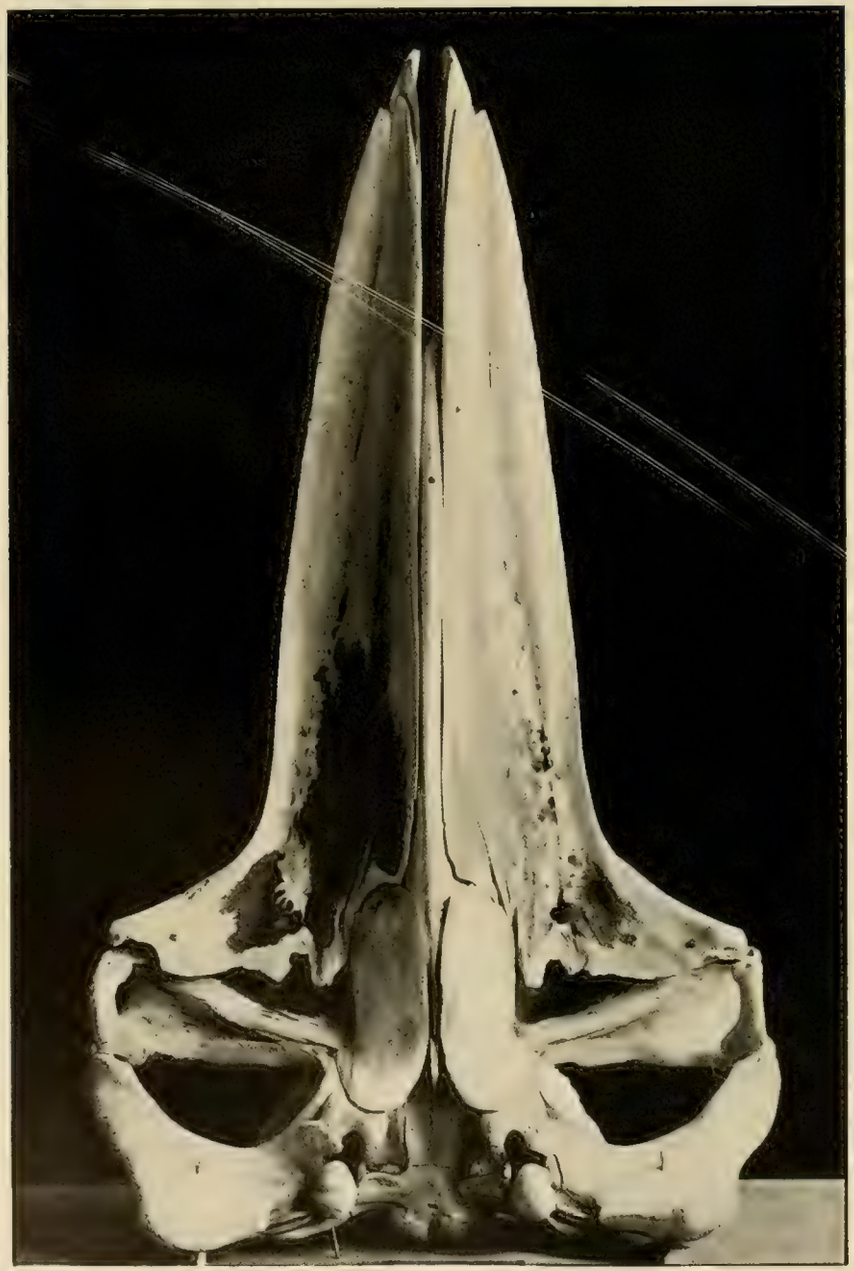


FIG. 1.

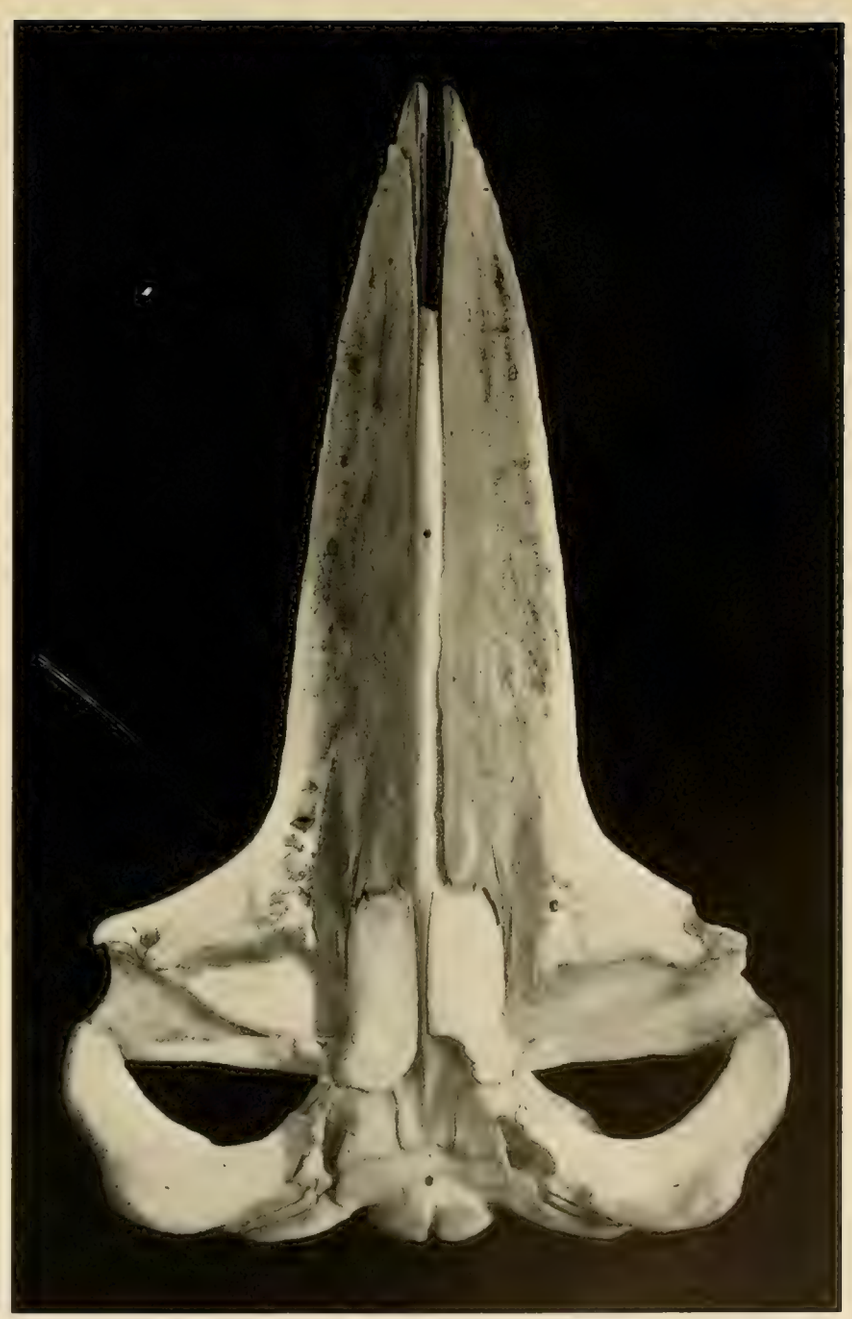


FIG. 2.

CRANIUM OF *MEGAPTERA NODOSA* (BONNATERRE). VENTRAL VIEW.

Fig. 1.—Provincetown, Mass., Jr., No. 16252 U. S. N. M. Fig. 2.—Cape Cod, Mass. (Milwaukee Public Museum.)

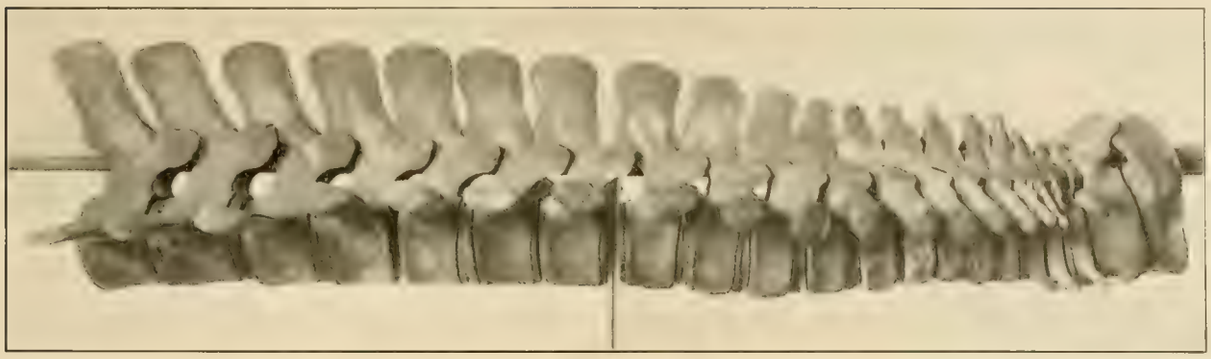


FIG. 1.

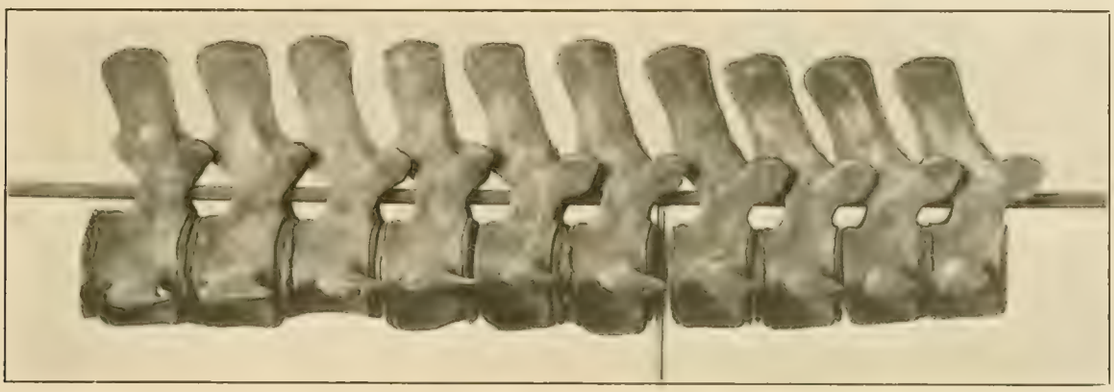


FIG. 2.

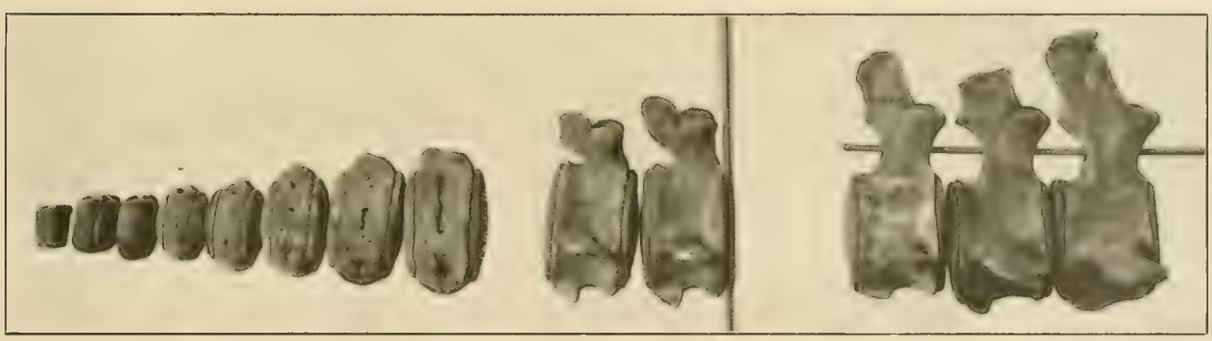


FIG. 3.

FIG. 4.

MEGAPTERA NODOSA (BONNATERRE). [TYPE OF *M. BELLICOSA* COPE.]

Fig. 1.—Cervical and dorsal vertebræ. Fig. 2.—Lumbar vertebræ. Fig. 3.—Caudal vertebræ.

Fig. 4.—Right scapula, humerus, and radius and ulna.

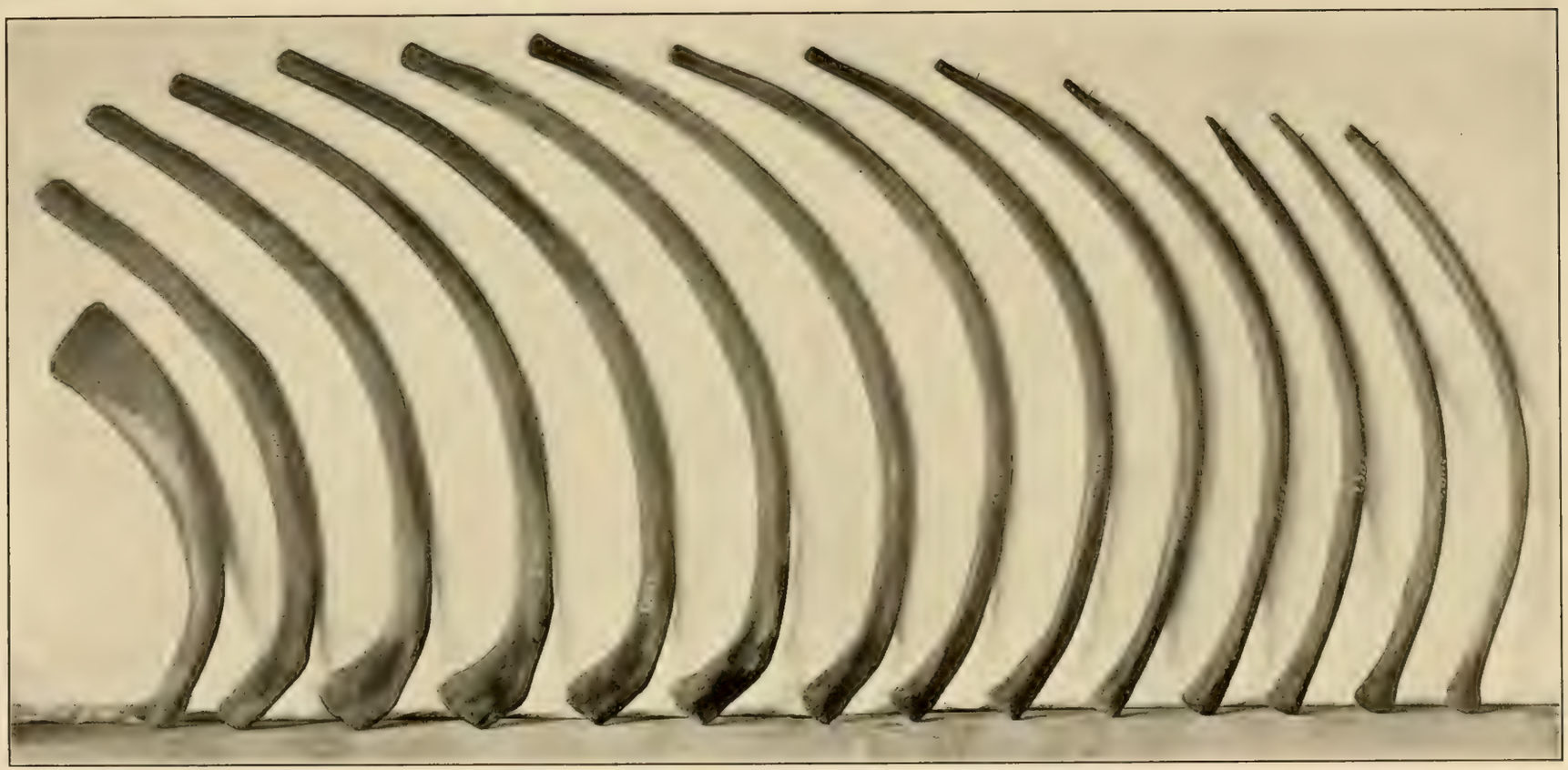


FIG. 2.

FIG. 1.

MEGAPTERA NODOSA (BONNATERRE). [TYPE OF *M. BELLICOSA* COPE.]

Fig. 1.—First lumbar vertebra, first dorsal vertebra, axis, and atlas. Fig. 2.—Ribs.

FIG. 1

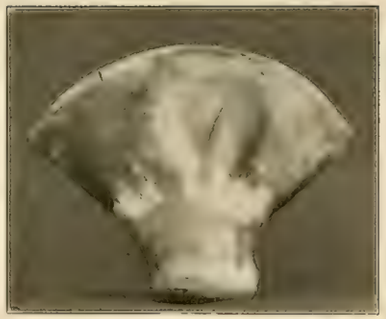


FIG. 4.

FIG. 5.

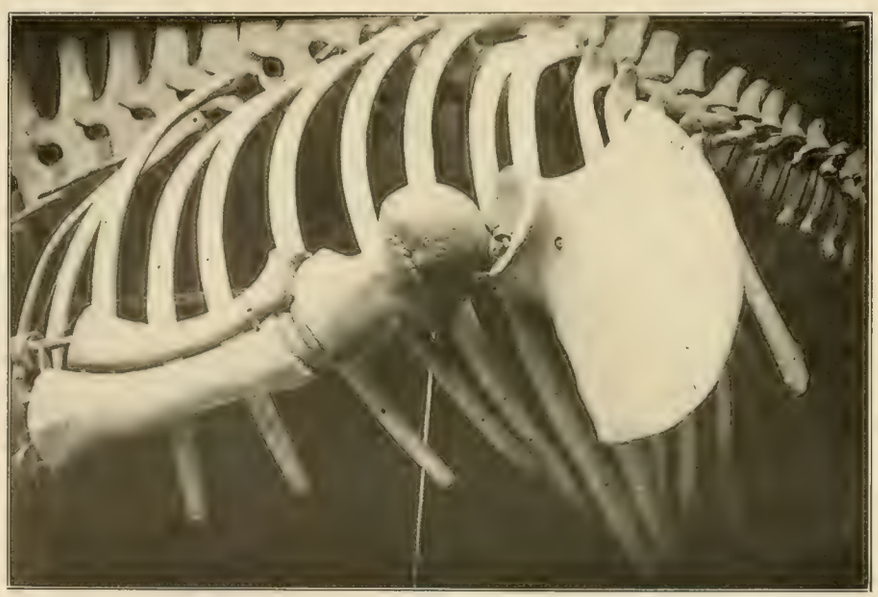


FIG. 3.

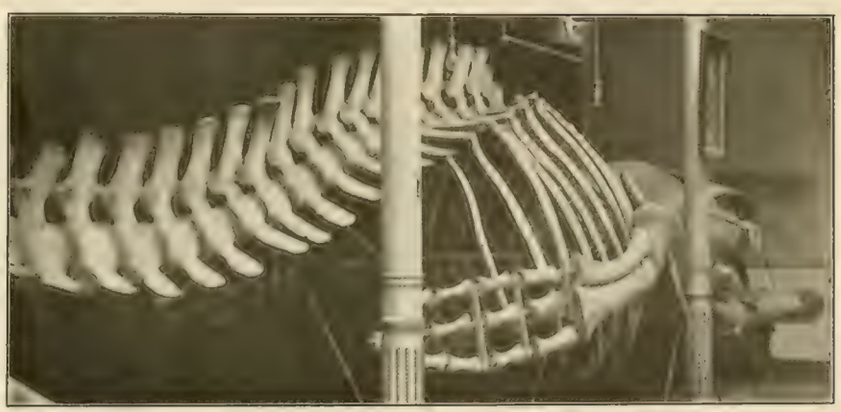


FIG. 2.

MEGAPTERA NODOSA (BONNATERRE).

Fig. 1.—Type of *M. osphyia* Cope; skull. Fig. 2.—*Ditto;* general view of skeleton. Fig. 3.—*Ditto:* pectoral limb and ribs.
Fig. 4.—*M. nodosa*, Provincetown, Mass., Jr., No. 16252 U. S. N. M.; right scapula. Fig. 5.—*Ditto*, Cape Cod, Mass., No. 21402 U. S. N. M.

FIG. 1.

FIG. 2.

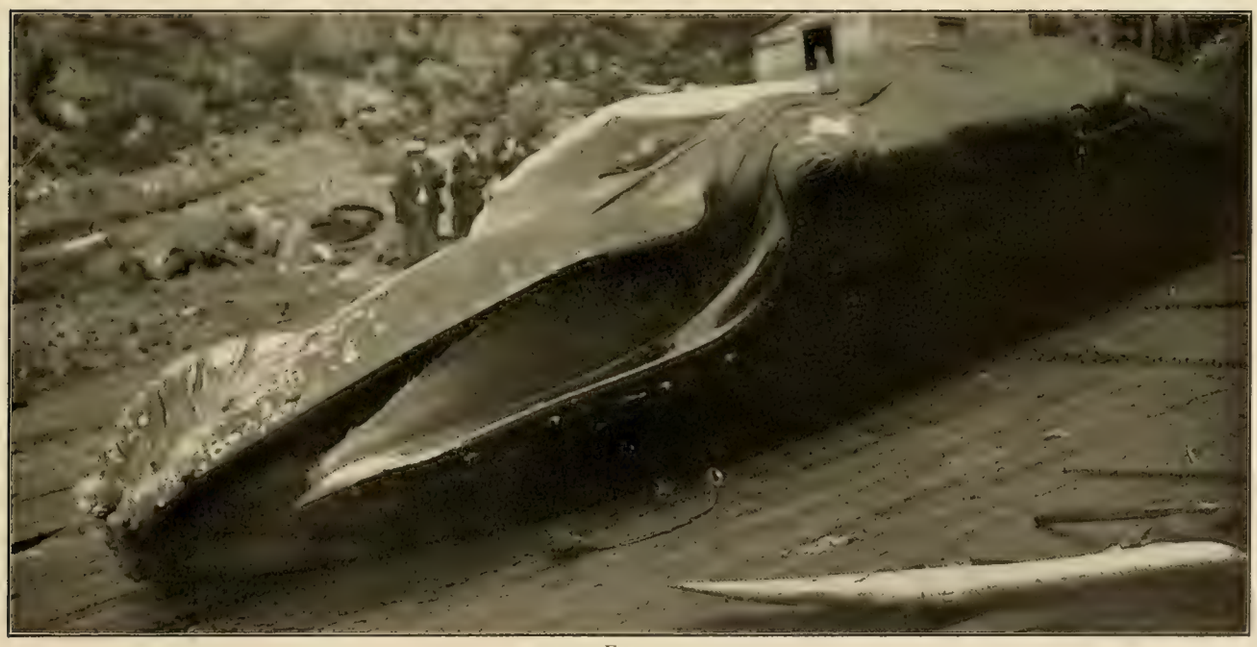


FIG. 3.

MEGAPTERA NODOSA (BONNATERRE).

Figs. 1–3.—Snook's Arm, Newfoundland, No. 5, ♂.

FIG. 1.

FIG. 2.

MEGAPTERA NODOSA (BONNATERRE). BALENA STATION, NEWFOUNDLAND.

Fig. 1.—A very white individual, 1903. Fig. 2.—Another specimen, 1903.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

MEGAPTERA NODOSA (BONNATERRE). SNOOK'S ARM, NEWFOUNDLAND.

Fig. 1.—No. 5, ♂. Figs. 2 and 3.—No. 6, ♀. Fig. 4.—No. 21, ♀.

FIG. 1.

FIG. 4.

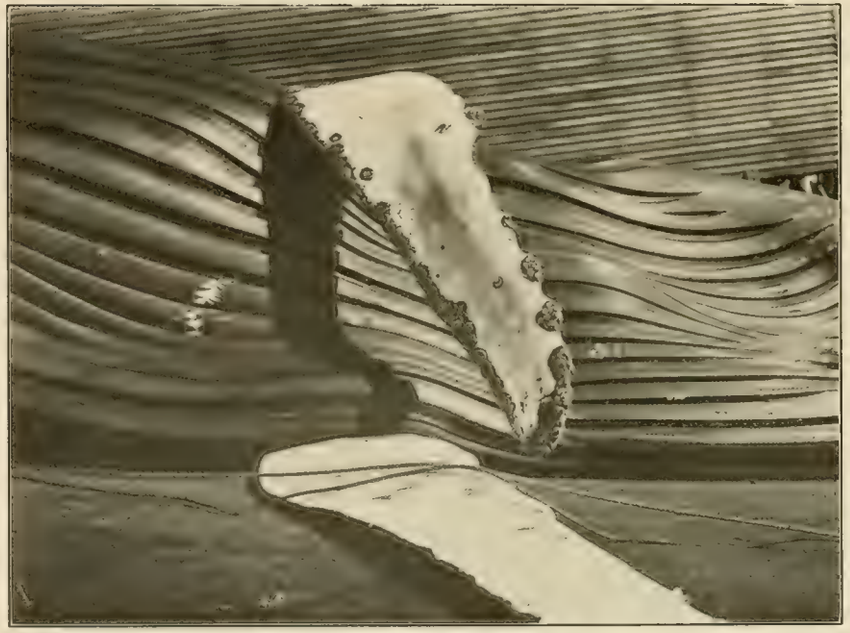


FIG. 3.

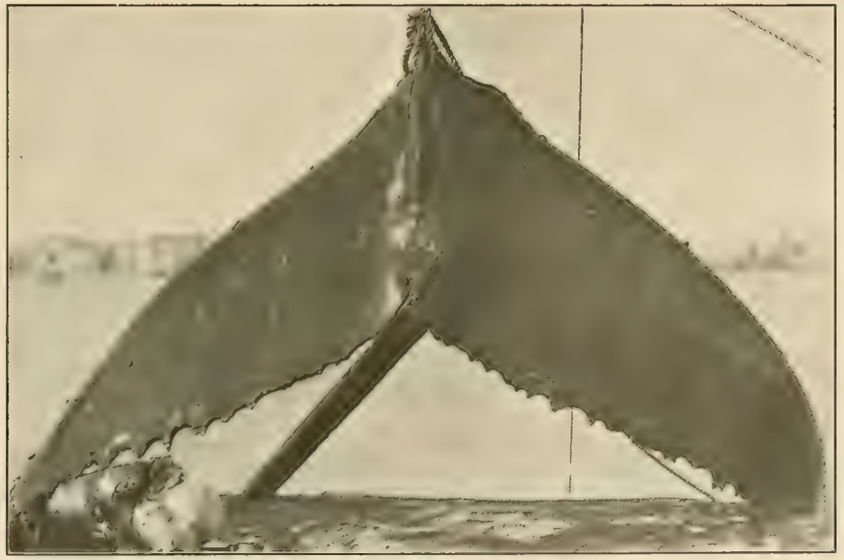


FIG. 2.

MEGAPTERA NODOSA (BONNATERRE) AND *M. VERSABILIS* COPE.

Fig. 1.—*M. nodosa*, Provincetown, Mass. Fig. 2.—*Ditto*, No. 13656 U. S. N. M.; flukes. Fig. 3.—Snook's Arm, Newfoundland, No. 21, ♀. Fig. 4.—*M. versabilis*, California.

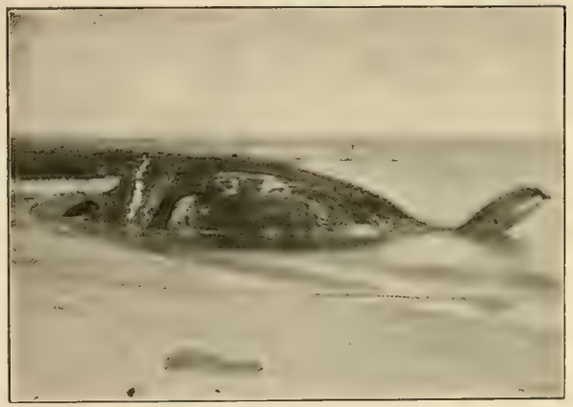


FIG. 5.

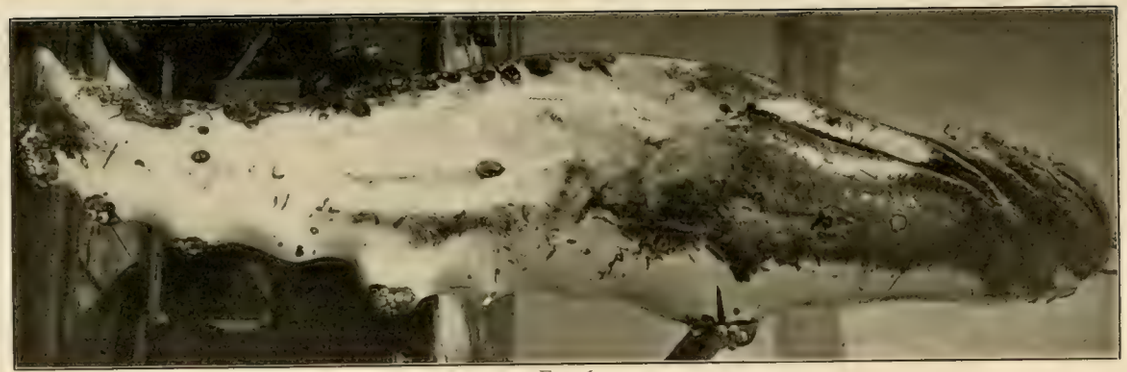


FIG. 6.

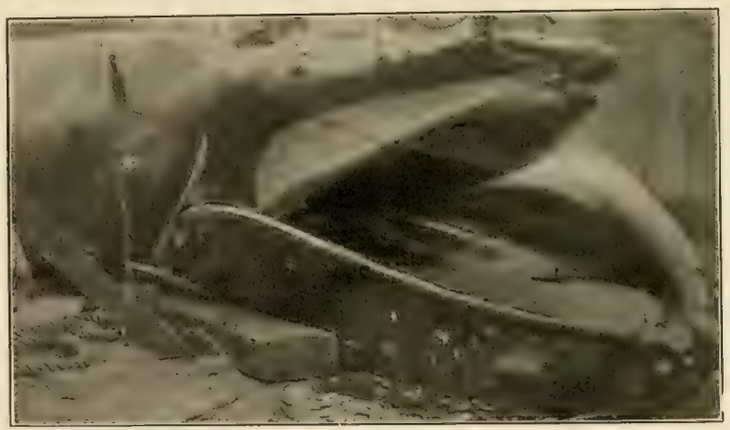


FIG. 4.

FIG. 3.

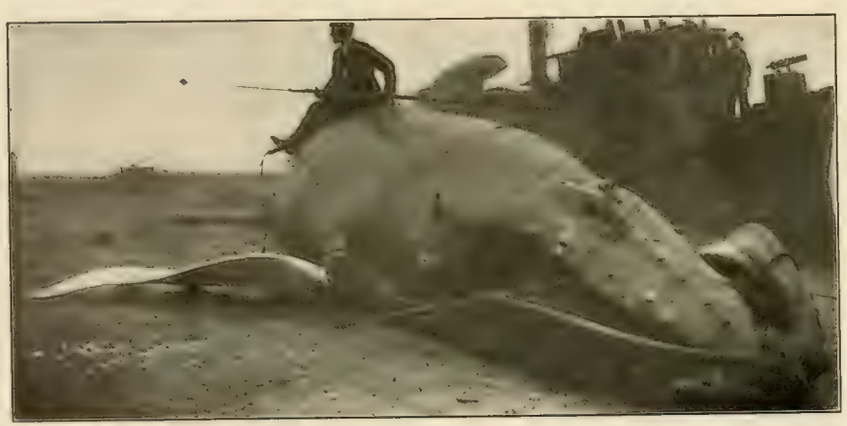


FIG. 1.

FIG. 2.

MEGAPTERA VERSABILIS COPE AND *M. NODOSA* (BONNATERRE).

Figs.—1–4. *M. versabilis*, Puget Sound, Washington. Fig. 5.—*Ditto*, California. Fig. 6.—*M. nodosa*, Provincetown, Mass.; right pectoral fin of No. 13656 U. S. N. M.

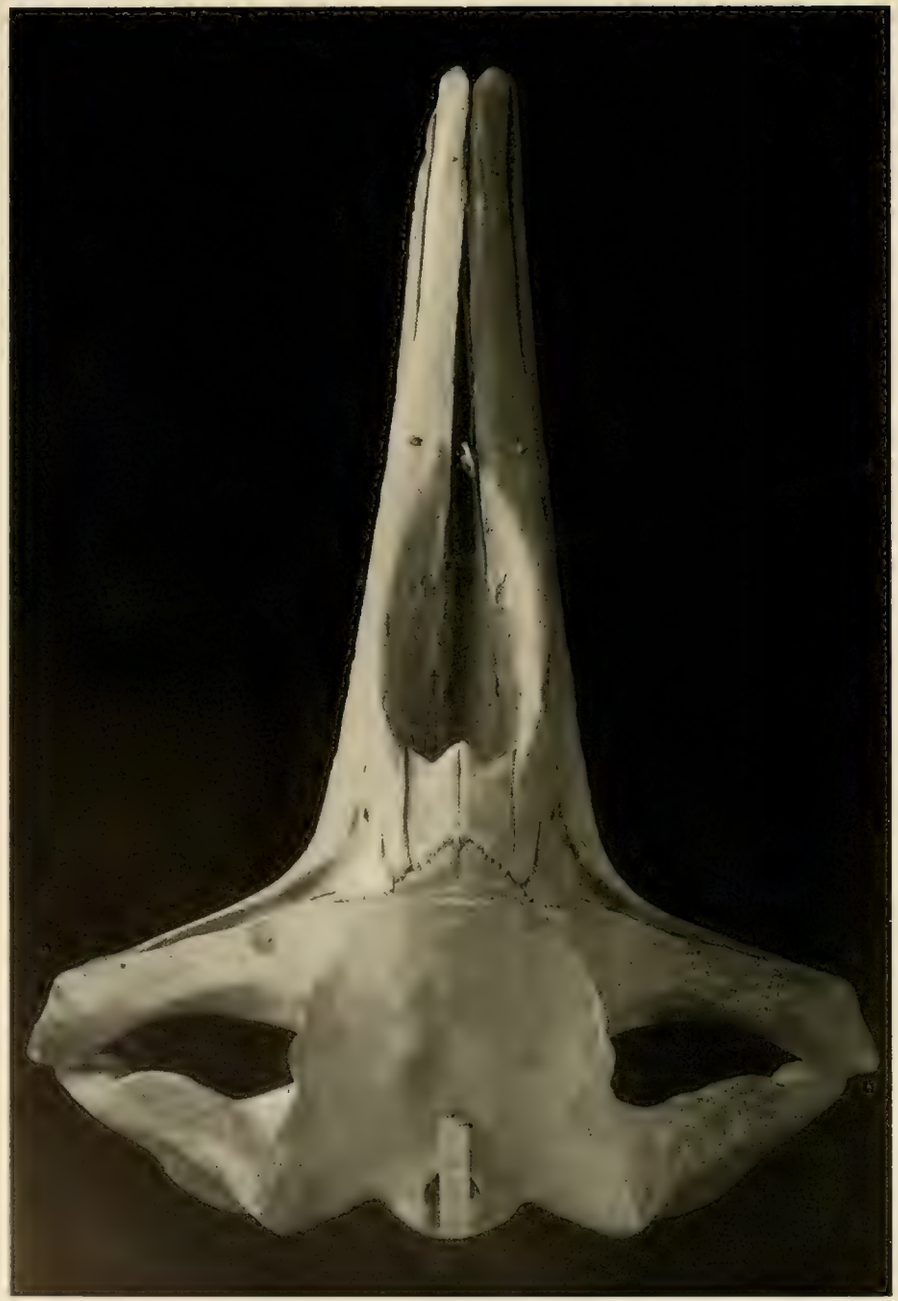


FIG. 1.

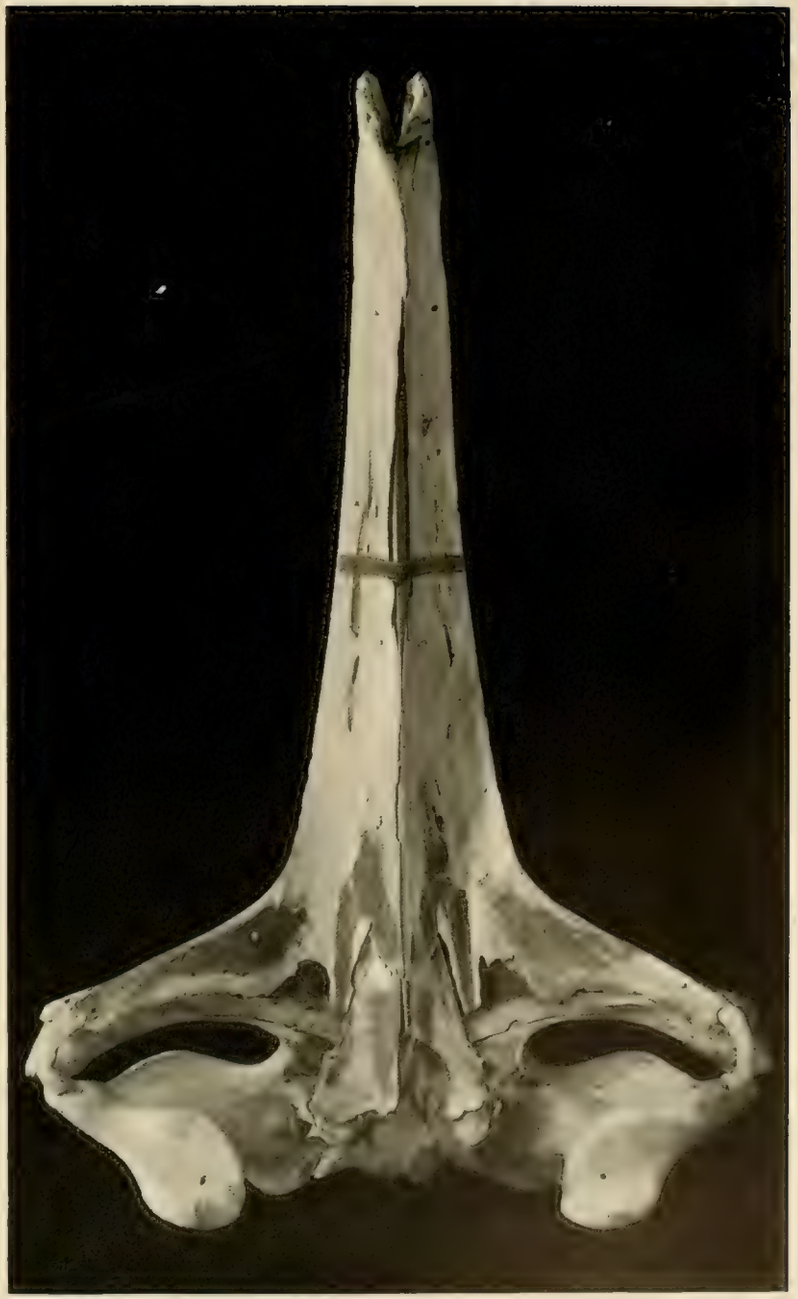


FIG. 2.

CRANIUM OF *BALÆNA GLACIALIS* BONNATERRE. LONG ISLAND, NEW YORK

Fig. 1.—No. 23077 U. S. N. M., dorsal view. Fig. 2.—*Ditto*, ventral view.

FIG. 1.

FIG. 2.

CRANIUM OF *BALÆNA GLACIALIS* BONNATERRE. LATERAL VIEW.

Fig. 1.—Long Id., New York, No. 23077 U. S. N. M. Fig. 2.—Cape Lookout, North Carolina. (State Museum, Raleigh, N. C.)

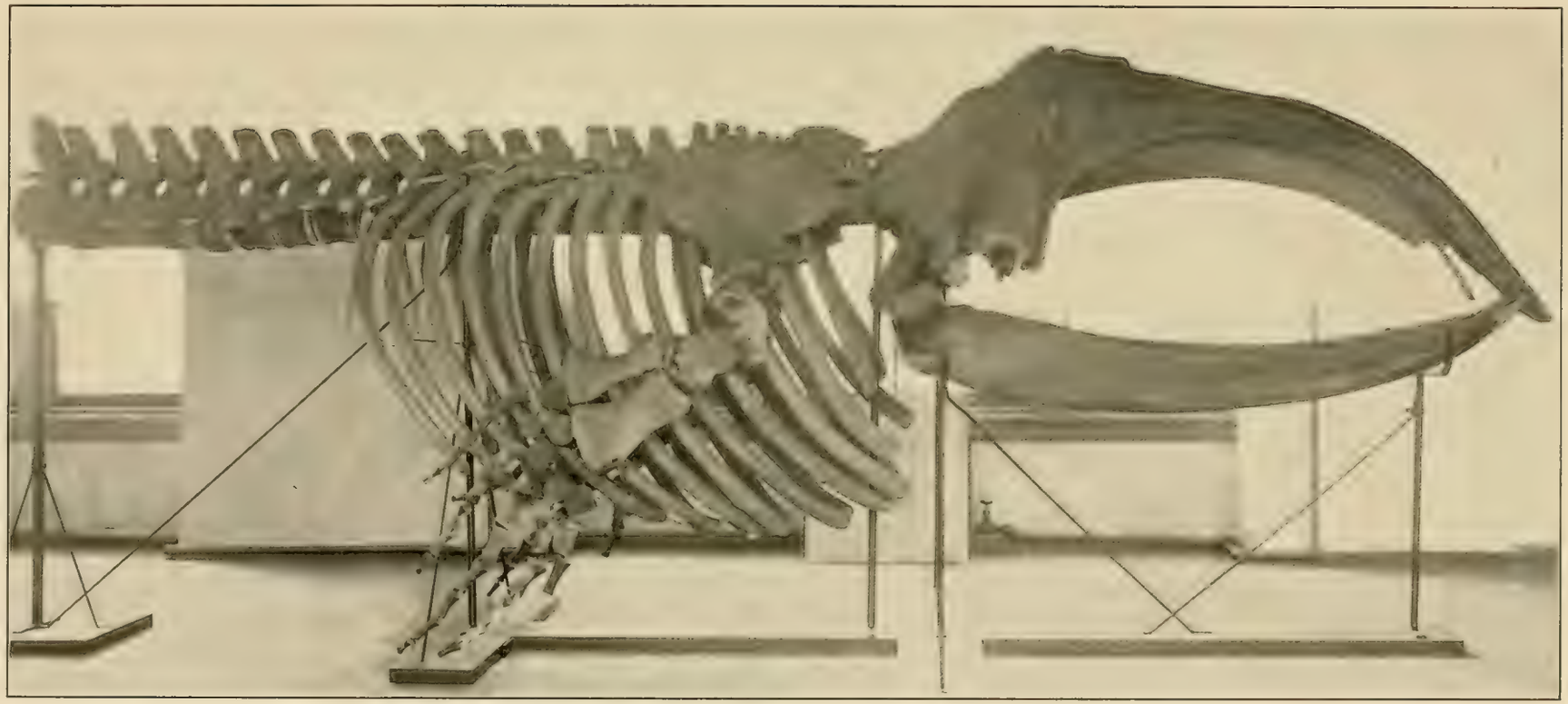


FIG. 1.

FIG. 2.

BALÆNA GLACIALIS BONNATERRE. [TYPE OF *B. CISARCTICA* COPE.]

Fig. 1.—Anterior portion of skeleton. Fig. 2.—Caudal vertebræ.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 1.

FIG. 2.

BALÆNA GLACIALIS BONNATERRE

Figs. 1 and 2.—Charleston Harbor, South Carolina. (Charleston College Museum.) Fig. 3.—Long Id., New York. (American Museum of Natural History), left scapula. Fig. 4.—*Ditto*, Field Columbian Museum; left scapula. Fig. 5.—*Ditto*, No. 23077 U. S. N. M.; left scapula.

FIG. 1

FIG. 3.

FIG. 2.

FIG. 4.

BALÆNA GLACIALIS BONNATERRE

Figs. 1 and 2.—Provincetown, Mass. Fig. 3.—Long Id., New York. (Field Columbian Museum); sternum. Fig. 4.—*Ditto*, Museum of Comparative Zoölogy; sternum.

FIG. 1.

FIG. 2.

FIG. 3.

CRANIUM OF *RHACHIANECTES GLAUCUS* COPE.

Figs. 1–3.—Monterey, California, No. 13803 U. S. N. M.

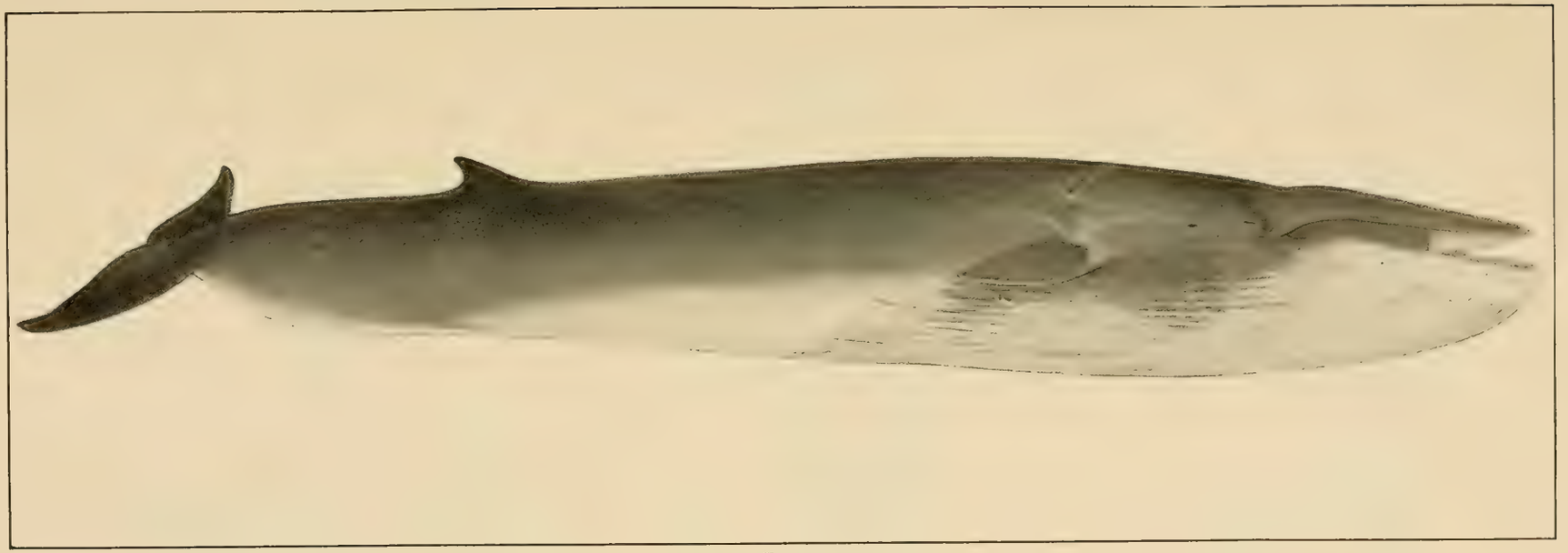


FIG. 1.

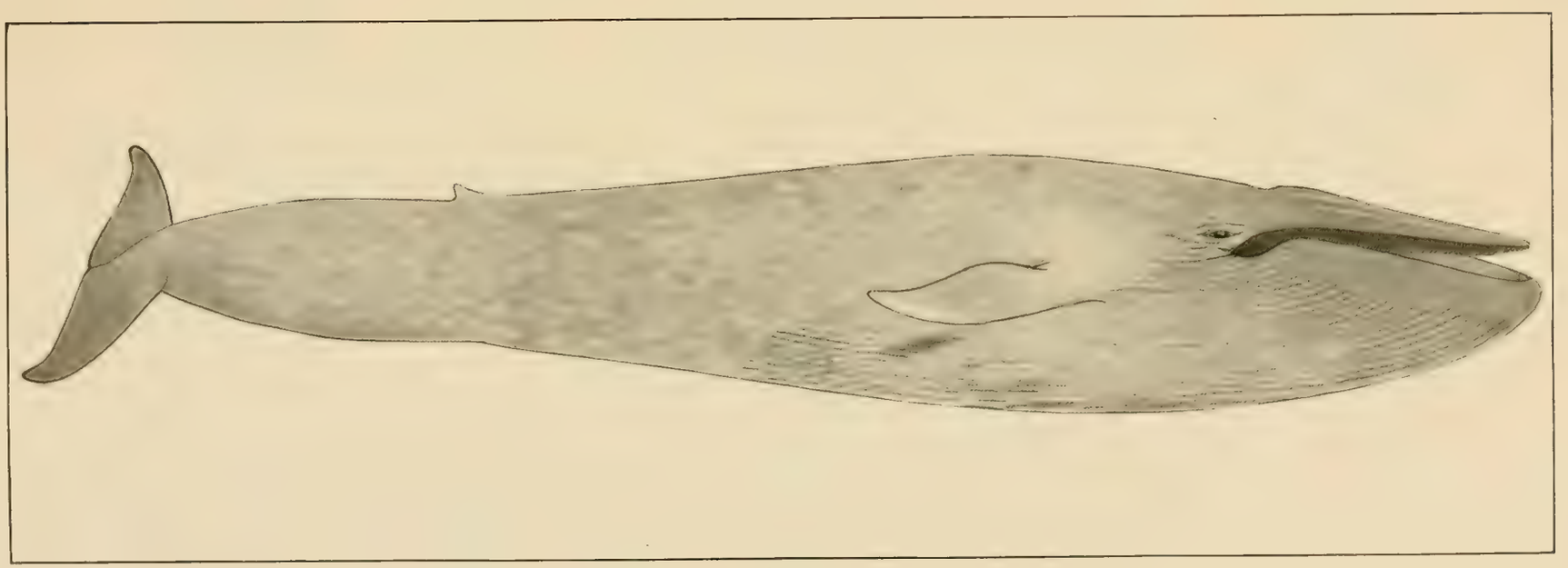


FIG. 2.

FIG. 1.—COMMON FINBACK, *BALÆNOPTERA PHYSALUS* (LINNÆUS). FIG. 2.—SULPHURBOTTOM, *BALÆNOPTERA MUSCULUS* (LINNÆUS).

FIG. 1.

FIG. 2.

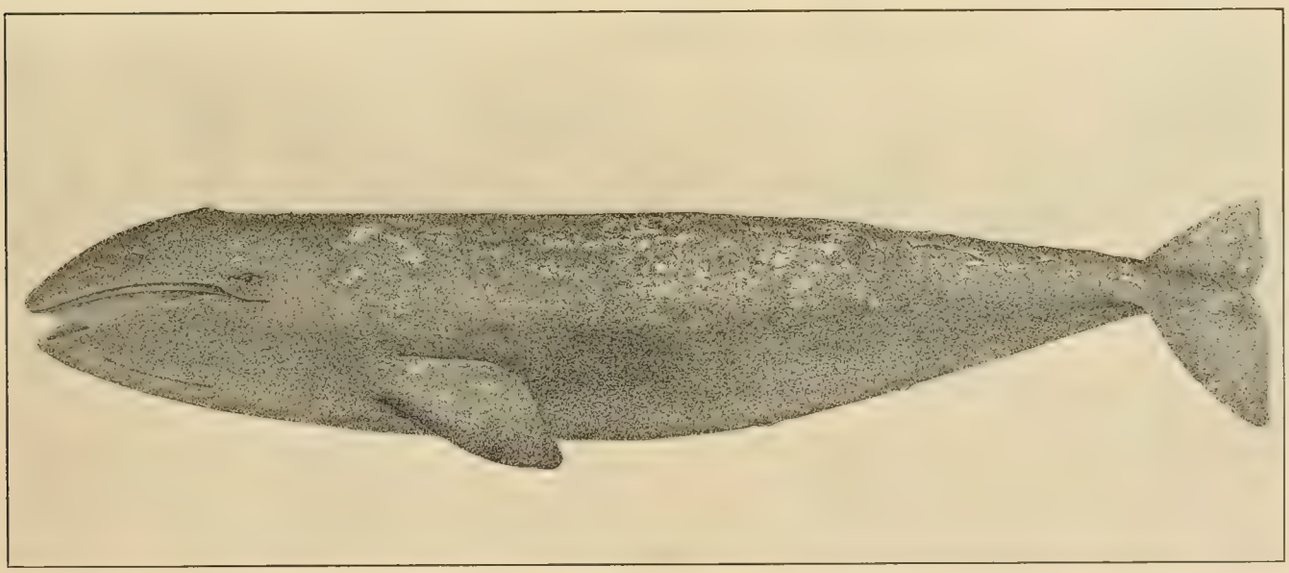


FIG. 3.

FIG. 1.—LITTLE PIKED WHALE, *BALÆNOPTERA ACUTO-ROSTRATA* LACÉPÈDE

FIG. 2.—POLLACK WHALE, *BALÆNOPTERA BOREALIS* (LESSON).

FIG. 3.—CALIFORNIA GRAY WHALE, *RHACHIANECTES GLAUCUS* COPE

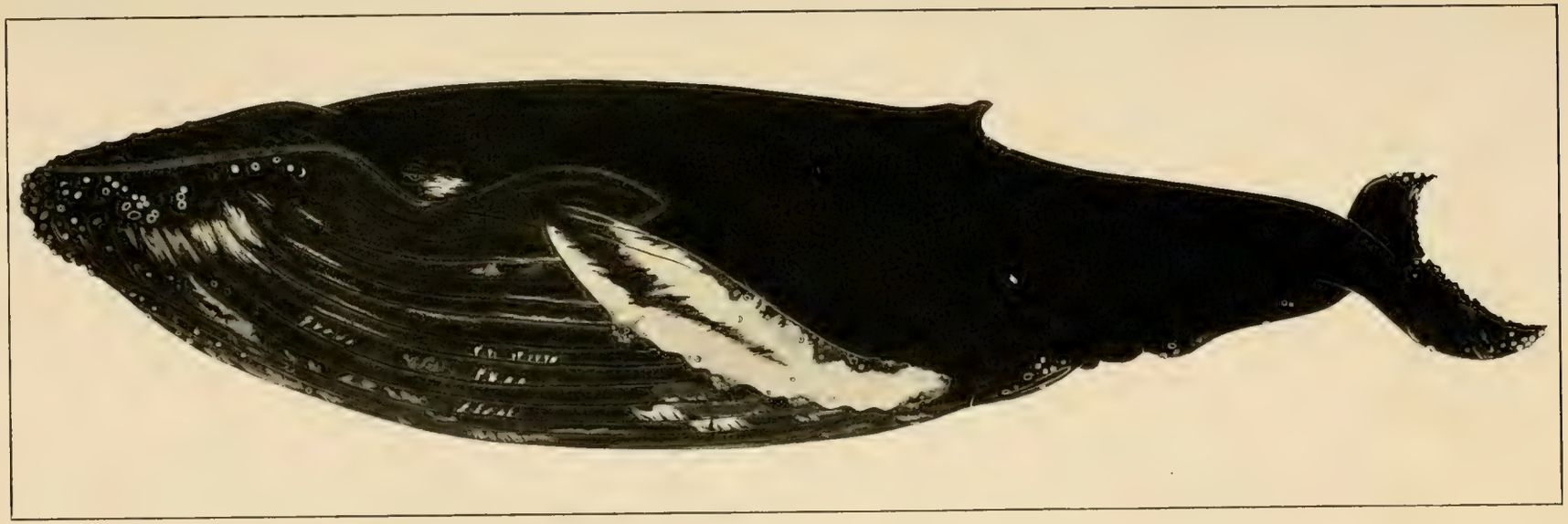


FIG. 1.

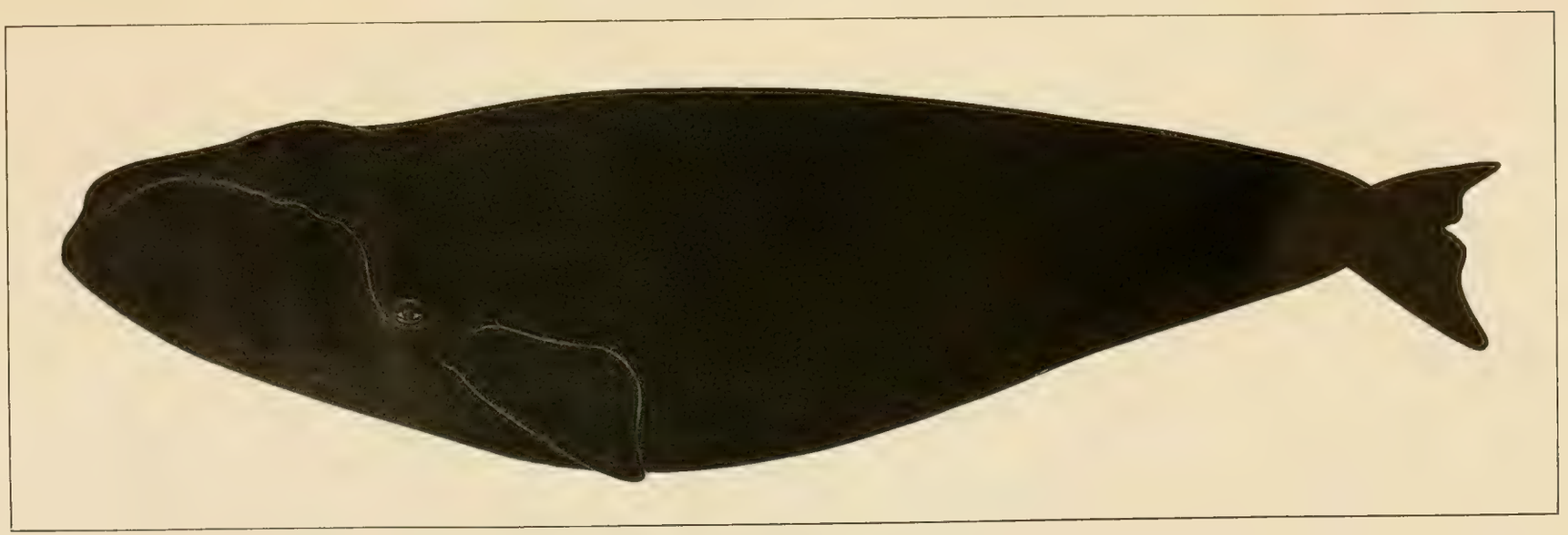


FIG. 2.

FIG. 1.—NORTH ATLANTIC HUMPBACK, *MEGAPTERA NODOSA* (BONNATERRE). FIG. 2.—NORTH ATLANTIC RIGHT WHALE, *BALÆNA GLACIALIS* BONNATERRE.

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE

VOL. XXXIII.

THE WHALEBONE WHALES

OF THE

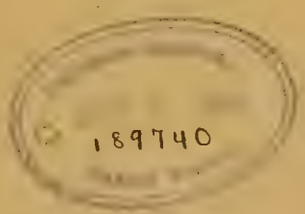
WESTERN NORTH ATLANTIC

COMPARED WITH THOSE OCCURRING IN EUROPEAN WATERS WITH SOME OBSERVATIONS ON THE SPECIES OF THE NORTH PACIFIC

BY

FREDERICK W. TRUE

HEAD CURATOR, DEPARTMENT OF BIOLOGY, UNITED STATES NATIONAL MUSEUM



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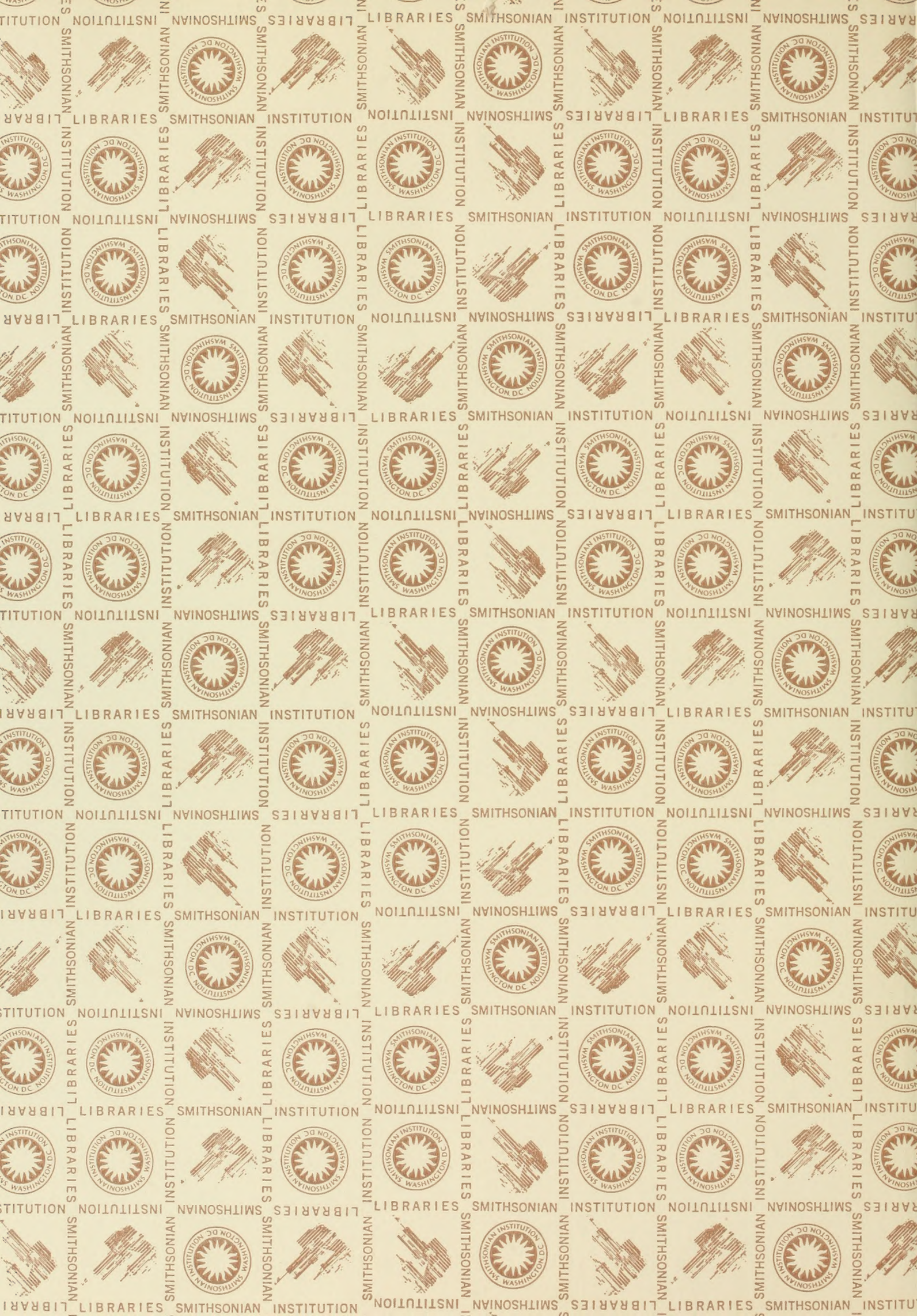
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